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Louisville Army Corps of Engineers
Attn: Mr. Kevin Mieczkowski PE, Technical Manager
600 Dr. Martin Luther King Jr. Place
Louisville KY 40202

10 June 2019

Subject: Second Update and Progress Report for Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station, Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio

Dear Mr. Mieczkowski:

Sampling was conducted in February and March 2018 to address data gaps at CC RVAAP-69 Building 1048 Fire Station as proposed in the *Final Work Plan, Additional Sampling for CC RVAAP-69 Building 1048 Fire Station, CC RVAAP-70 East Classification Yard, and CC RVAAP-74 Building 1034-Motor Pool Hydraulic Lift, Ravenna Army Ammunition Plant Restoration Program, Camp Ravenna, Portage and Trumbull Counties, Ohio*, November 30, 2017. Two additional soil borings and four additional monitoring wells were installed in December 2018 in accordance the *Update and Progress Report on Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station, Ravenna Army Ammunition Plant Restoration Program, Camp Ravenna, Portage and Trumbull Counties, Ohio*, July 2018. Monitoring wells were sampled in March 2018, June 2018, December 2018 and March 2019.

The purpose of this letter is to update the team with results to date and outline additional sampling to complete the Remedial Investigation. The additional sampling and analyses described in this Second Update and Progress Report letter are consistent with the objectives of the Work Plan and will follow methodologies described the Work Plan.

Objectives of Additional Sampling

The Final Work Plan (Parsons 2017) contained the following objectives for investigations at CC RVAAP-69:

- Define the vertical extent of carbon tetrachloride in soil near SB101;
- Define the lateral extent of carbon tetrachloride contamination is soil below a depth of 1,018 feet above mean sea level (AMSL); and
- Evaluate impacts to groundwater.

Investigation activities to meet those objectives have been conducted since February 2018.

February / March 2018 Investigation Activities

- Drilled 4 soil borings and collected soil samples from: SB110 (28 feet below ground surface [bgs]); SB111 (23 feet bgs); SB112 (14 feet bgs) and SB113 (24 feet bgs).
- Collected groundwater grab (screening) samples using direct push drilling techniques at 17 locations (all samples collected near water table). Note that groundwater grab samples were screening samples and results were used to locate permanent monitoring wells.
- Installed and sampled 5 permanent monitoring wells; four wells (069MW-001, 069MW-002, 069MW-004 and 069MW-005) which are screened at the water table (screens set from 5-15 or 7-17 feet bgs) and one well (069MW-003) which is screened in unconsolidated weathered sandstone (uppermost portion of Upper Sharon Aquifer, 23-28 feet bgs).
- Three additional monitoring wells were also installed and sampled at nearby CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift, and these provide information useful to CC RVAAP-69.

June 2018 Investigation Activities

- Sampled 5 permanent monitoring wells at CC RVAAP-69 (069MW-001, 069MW-002, 069MW-003, 069MW-004 and 069MW-005) as well as three wells at nearby CC RVAAP-74.

December 2018 Investigation Activities

- Drilled 2 soil borings and collected soil samples from: SB114 (24 feet bgs) and SB115 (28 feet bgs).
- Installed four additional permanent monitoring wells (069MW-006, 069MW-007, 069MW-008 and 069MW-009) which are screened at the water table (screens set from 5-15 or 7-17 feet bgs).
- Sampled all nine monitoring wells at CC RVAAP-69 and the three wells at nearby CC RVAAP-74.

March 2019 Investigation Activities

- Sampled all 9 permanent monitoring wells at CC RVAAP-69. Gauged all 9 wells plus 3 wells at nearby CC RVAAP-74.

Summary of Findings

Historical and 2018 sampling locations are illustrated in Figure 1. Soil sampling results are presented in Table 1. Water table gauging results are presented in Table 2. Groundwater monitoring well results are presented in Table 3.

Soil

Soil sampling results for carbon tetrachloride are illustrated in plan view in Figure 2, in updated cross section view in Figures 3 and 4, and are summarized below.

- Subsurface geology is primarily brown clays with interbedded silts and sands from the surface to as deep as 15 to 19 feet bgs. (1,006 to 1,010 feet AMSL). A layer of gray clay was encountered below the brown clays. The gray clay is consistently 4 to 5 feet thick across the Area of Concern. Weathered bedrock was encountered below the gray clay at about depths ranging from 1,000 to 1,010 feet AMSL. Hollow stem auger refusal was encountered at 28 feet bgs (997 feet AMSL) at SB110. Photographs of soil cores from SB110 are attached.
- Carbon tetrachloride and chloroform were detected in soil samples at depths above 14 feet bgs (in the brown clays, sands and silts), which is consistent with previous investigations. Methylene chloride was detected in only one soil sample. Chloromethane was not detected in any soil sample (Table 1).
- The highest concentrations (> 1 mg/kg) of carbon tetrachloride in soil are primarily within the footprint of the former Building 1048 Fire Station (SB101, SB104, SB110, SB112, SB114 and RV5-SB2 on Figures 2 and 3).
- SB110 and SB114 show no soil impacts in or below the gray clay (below about 1,006 ft AMSL) (Figure 3). Soil contamination is vertically delineated.
- SB111 and SB113 delineate the lateral extent of contamination in soil to the north and south (Figure 4). DU3-SB1 and SB107 delineate soil contamination to the west, and SB102, SB106 and SB115 delineate soil contamination to the east (Figure 3). Soil contamination is laterally delineated and appears to be confined to the footprint of the former fire station.

Groundwater Presence and Gradients

Groundwater elevations were gauged several times between March 2018 and March 2019 (Table 2). The most recent event (March 2019) included the 12 wells and the potentiometric surface from these measurements is illustrated in Figure 5. Observations are summarized below:

- The interpreted water table potentiometric surface indicates an overall gradient to the southeast (Figure 5) with local variations. Potentiometric surface elevations and gradient are consistent with facility wide potentiometric surface maps for the unconsolidated aquifer as presented in Facility-Wide Groundwater Annual Reports.
- The potentiometric surface is mounded in two locations (near well 069MW-001 and near 069MW-009). The ground surface near well 069MW-001 is a slight depression where water ponds during wet times of the year. The water table near wells 069MW-004 and 069MW-005 is lower than surrounding wells, but there are currently not enough control points to the east to determine if this is a depression (sink) in the water table or an area where the potentiometric surface flattens.
- Hydraulic head in Well 069MW-001 (screened 5-15 feet bgs) ranges between 1,013.02 feet AMSL and 1020.28 feet AMSL. Hydraulic head in paired deep well 069MW-003 (screened 23-28 feet bgs) ranges between 1009.89 feet AMSL and 1,013.23 feet AMSL. There is a consistent vertical (downward) gradient from shallow groundwater in the unconsolidated overburden to the weathered bedrock at the top of the Upper Sharon Aquifer. The head difference between the two wells (3.35 feet to 7.16 feet) suggests that

the gray clay layer (located between the two screened intervals) is limiting vertical migration of groundwater.

Groundwater Contamination

Groundwater sampling results are presented in Table 3, and illustrated in Figure 6, and are summarized below.

- Primary contaminants in groundwater are carbon tetrachloride and chloroform. Lower concentrations of methylene chloride were also sporadically detected and are generally coincident with higher concentrations of chloroform. Chloromethane was not detected in any sample.
- Monitoring wells sample results are presented in Table 3 and Figure 6:
  - Carbon tetrachloride and chloroform were detected in five of the eight water table wells. Carbon tetrachloride concentrations were > 100 µg/L in wells 069MW-001 and 069MW-004.
    - Carbon tetrachloride concentrations exceeded the MCL of 5 µg/L in at least one sample from wells 069MW-001, 069MW-002, 069MW-004 and 069MW-005.
    - Chloroform concentration exceeded the MCL of 80 µg/L in well 069MW-004.
  - All wells are gauged for DNAPL but none was detected. Carbon tetrachloride DNAPL is unlikely to be present because dissolved concentrations in groundwater are much lower that the solubility limit of 800,000 µg/L.
  - Lateral delineation in the shallow groundwater in the unconsolidated overburden:
    - The VOC plume extent is defined to the northwest (by well 069MW-006) and southeast (by wells 069MW-008 and 069MW-009).
    - Relatively low concentrations of carbon tetrachloride and chloroform in well 069MW-007 in March 2019 suggest the plume is not fully delineated to the southwest. However, given the potentiometric surface, it is unlikely that the plume extends much further in the southwest direction.
    - Detections of carbon tetrachloride and chloroform in well 069MW-005 suggest that the plume is not delineated in the east or northeast direction (downgradient).
  - Samples from deep well 069MW-003 have contained chloroform and methylene chloride but not carbon tetrachloride. Concentrations were highest in the initial sample event (March 2018) but have decreased to less than 1 µg/L (sometimes non-detect) in subsequent monitoring events. These contaminants were most likely introduced during drilling the well, and migration from the shallow groundwater in the overburden to the unconsolidated weathered bedrock at the top of the Upper Sharon Aquifer is very limited at this location.

Potential Vapor Intrusion

- The only currently occupied building near the site is Range Control (located east of CC RVAAP-69).
- Carbon tetrachloride (up to 8.7 µg/L) and chloroform (up to 1.4 µg/L) were detected in groundwater at 069MW-005 (140 feet west of the Range Control Building).

- The USEPA Vapor Intrusion Screening Level (VISL) calculator indicates that carbon tetrachloride concentrations below 27.7 µg/L and chloroform concentrations below 53.3 µg/L in groundwater will not pose a cancer risk above 10^{-5}.
- Current data suggest no unacceptable risk from vapor intrusion to occupants of the Range Control Building.

Actions to Complete the Remedial Investigation:

The following actions are designed to complete the Remedial Investigation CC RVAAP-69 Building 1048 Fire Station.

- Vertical and lateral delineation of carbon tetrachloride and chloroform in soil is complete. No further soil sampling is needed.
- Complete delineation of carbon tetrachloride and chloroform in shallow (overburden) groundwater by installing and sampling two additional shallow monitoring wells (Figure 7).
  - New wells 069MW-010 and 069MW-011 will be located east of 069MW-005 and west of the Range Control Building. Wells will be screened in the unconsolidated overburden above the gray clay layer.
- Investigate potential vertical migration of carbon tetrachloride reductive dechlorination intermediate products (e.g., chloroform) in groundwater.
  - Continue to monitor deep monitoring well 069MW-003.
  - Although there does not appear to be vertical migration at well 069MW-003 and the gray clay layer appears to be contiguous across the Area of Concern, the "low" in the potentiometric surface near wells 069MW-004 and 069MW-005 could indicate a groundwater pathway between the unconsolidated overburden and the underlying Upper Sharon Aquifer. Therefore, a new deep well 069MW-012 will be installed adjacent to 069MW-004 (Figure 7). The deep well will be screened below the bottom of the gray clay layer (below 1,000 feet AMSL) in weathered bedrock above the competent bedrock of the Upper Sharon Aquifer. The borehole will be sealed above the screen to prevent migration of contaminants from the shallow groundwater above the clay layer.
- Depending on future monitoring results, additional step-out wells may be required to complete the Remedial Investigation:
  - Additional shallow monitoring wells may be required to delineate the plume:
    - If carbon tetrachloride and chloroform continue to be detected above the FWCUG in well 069MW-007, a new well may be needed south or southwest of 069MW-007.
    - If the new wells 069MW-010 and 069MW-011 show the groundwater flow in a more northerly direction than anticipated, an additional well may be needed north of 069MW-005.
    - If carbon tetrachloride or chloroform are detected at concentrations above FWCUGs in new wells 069MW-010 and 069MW-011, additional delineation wells will be required.

- If monitoring at 069MW-003 or new well 069MW-012 indicates migration of carbon tetrachloride or chloroform to the unconsolidated weathered bedrock at the top of the Upper Sharon Aquifer, additional deep monitoring wells will be required.

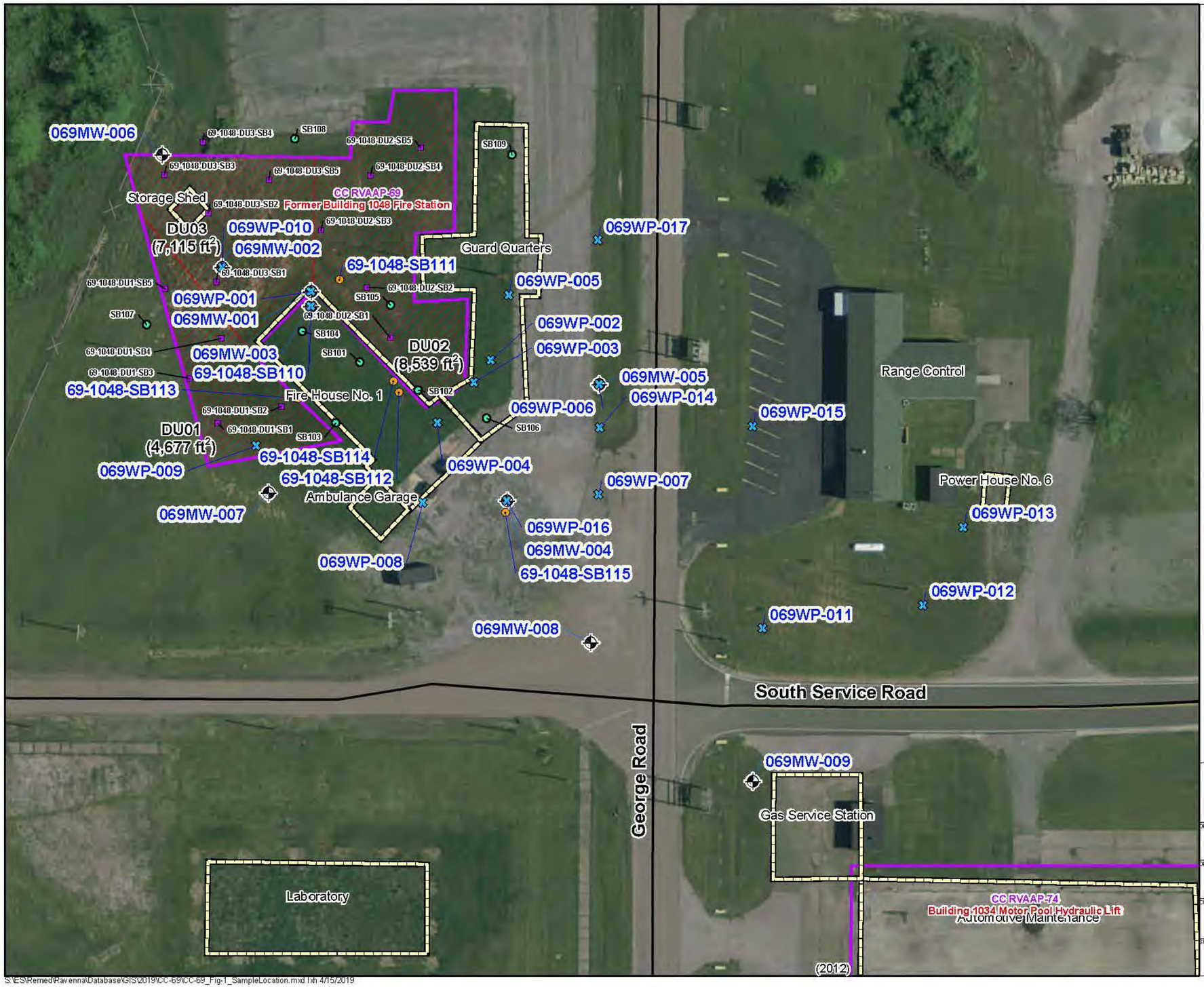
Please contact me at 256.217.2573 or email ed.heyse@parsons.com if you have any questions.

Sincerely

Edward Heyse, PhD, PE
Project Manager

CC: Ed D'Amato, Ohio EPA DERR-NEDO (1 electronic copy)
Tom Schneider, Ohio EPA, SWDO (transmittal letter only)
Mark Johnson, Ohio EPA, DERR-NEDO (transmittal letter only)
Bob Princic, Ohio EPA, DERR-NEDO (transmittal letter only)
David Connolly, ARNG-ILE-CR (1 electronic copy)
Craig Coombs, USACE Louisville (email transmittal letter only)
Kevin Sedlak, ARNG (1 electronic copy)
Katie Tait, OHARNG (1 electronic copy)
Gail Harris, RVAAP Administrative Record (1 electronic copy)
Pat Ryan, REIMS (email transmittal letter only)
Lauri Roché, Parsons

Attached
7 Figures
3 Tables
Boring Logs and Well Completion Diagrams
Photographs



Legend

- Installation Boundary
- Former UST RV-5 (100-gallon gasoline tank)
- 2012 Direct Push Boring Location
- 2015 Field Change Notice Subsurface Soil Boring
- 2018 Soil Sample Direct-Push Boring Location
- 2018 Groundwater Well Point Location (Grab Sample)
- 2018/2019 Groundwater Monitoring Well
- Area of Concern
- 2012 Decision Unit
- Fence Line
- Elevation contour (ft)
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. DU = Decision Unit
3. ID = Identification
4. RVAAP = Ravenna Army Ammunition Plant
5. CC = Army Environmental Compliance-Related Cleanup Program
6. ISM = Incremental Sampling Methodology
7. Initial groundwater grab sample locations are indicated on the figure. Subsequent step-in or step-out groundwater grab locations will be located in the indicated shaded area based on earlier grab sample results.

0 50 100 Feet

N

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT	**Figure 1**
DRAWN BY: LH	**Sampling Locations**
CHECKED BY: EH	**CC RVAAP-69 Building 1048 Fire Station**
SUBMITTED BY: EH	SCALE: As Shown; DATE: 4/15/2019; FILE:
PROJECT NUMBER: 640030.0005.110051	FIGURE NUMBER: 1

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69-1048-DU3-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-SB108
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]

69-1048-DU2-SB4
11/12/2012 : ND CT [1 - 7]

69-1048-DU2-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-DU2-SB
11/12/2012 : ND CT [1 - 4]
11/12/2012 : **0.0027J** CT [4 - 7]

69-1048-DU3-SB4
11/12/2012 : **0.0087** CT [1 - 7]

69-1048-DU3-SB
11/12/2012 : **0.002J** CT [1 - 4]
11/12/2012 : **0.0027J** CT [4 - 7]

C'

069MW-006

69-1048-DU3-SB3
11/12/2012 : **0.00072J** CT [1 - 7]

69-1048-DU3-SB2
11/12/2012 : **0.0014J** CT [1 - 7]

69-1048-DU2-SB3
11/12/2012 : ND CT [1 - 7]

CC RVAAP-69
Former Building 1048 Fire Station

69-1048-SB109
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

69-1048-DU2-SB2
11/12/2012 : **0.17** CT [1 - 7]

69-1048-SB111
02/06/2018 : **0.5** CT [13 - 14]
02/06/2018 : ND CT [19 - 20]
02/06/2018 : ND CT [22 - 23]

DU03
(7,115 ft²)

DU02
(8,539 ft²)

A

069MW-002

069MW-001

069MW-003

Guard Quarters

69-1048-SB105
04/07/2015 : ND CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : **0.0014J** CT [7 - 8]
04/07/2015 : **0.087** CT [7 - 10]
04/07/2015 : **0.7J** CT [9 - 10]

69-1048-DU1-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-DU2-SB1
11/12/2012 : **0.0012J** CT [1 - 7]

69-1048-DU3-SB1
11/12/2012 : **0.003J** CT [1 - 7]
11/12/2012 : **0.0027J** CT [7 - 13]

69-1048-SB114
12/04/2018 : 0.57 U CT [4 - 5]
12/04/2018 : **3.7J** CT [9 - 10]
12/04/2018 : **3.2** CT [14 - 15]
12/04/2018 : **1.9J** CT [14 - 15]
12/04/2018 : 0.46 U CT [19 - 20]

69-1048-SB107
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

RV-5

069MW-005

69-1048-DU1-SB4
11/12/2012 : **0.015** CT [1 - 7]

DU01
(4,677 ft²)

Fire House No. 1

69-1048-SB106
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

69-1048-DU1-SB3
11/12/2012 : ND CT [1 - 7]

A'

C

69-1048-SB110
02/06/2018 : **4.9** CT [11 - 12]
02/06/2018 : **7J** CT [11 - 12]
02/06/2018 : ND CT [19 - 20]
02/06/2018 : ND CT [22 - 23]
02/06/2018 : ND CT [27 - 28]

069MW-007

069MW-004

69-1048-DU1-SB
11/12/2012 : ND CT [1 - 4]
11/12/2012 : ND CT [4 - 7]

Ambulance Garage

69-1048-SB115
12/04/2018 : 0.47 U CT [7 - 8]
12/04/2018 : 0.49 U CT [11 - 12]
12/04/2018 : 0.47 U CT [18 - 19]
12/04/2018 : 0.46 UJ CT [22 - 23]

69-1048-DU1-SB1
11/12/2012 : ND CT [1 - 7]

69-1048-SB102
04/07/2015 : **0.00063J** CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : ND CT [7 - 8]
04/07/2015 : **0.52** CT [7 - 10]
04/07/2015 : **0.55J** CT [9 - 10]

69-1048-SB104
04/07/2015 : **0.31J** CT [2 - 3]
04/07/2015 : **1.4** CT [4 - 5]
04/07/2015 : **8.2J** CT [5 - 6]
04/07/2015 : **13J** CT [7 - 8]
04/07/2015 : **12J** CT [9 - 10]
04/29/2015 : **4.9J** CT [12 - 13]
04/29/2015 : **0.00086J** CT [14 - 15]

69-1048-SB103
04/07/2015 : ND CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : ND CT [7 - 8]
04/07/2015 : ND CT [7 - 10]
04/07/2015 : ND CT [9 - 10]

69-1048-SB112
02/06/2018 : **7.7J** CT [11 - 12]
02/06/2018 : **9.6** CT [11 - 12]

069MW-008

69-1048-DU1-SB2
11/12/2012 : ND CT [1 - 7]

69-1048-SB113
02/06/2018 : ND CT [10 - 11]
02/06/2018 : ND CT [17 - 18]
02/06/2018 : ND CT [22 - 23]

69-1048-SB101
04/07/2015 : **0.37J** CT [2 - 3]
04/07/2015 : **0.52** CT [4 - 5]
04/07/2015 : **4.7** CT [5 - 6]
04/07/2015 : **8.4J** CT [7 - 8]
04/07/2015 : **7.9J** CT [9 - 10]
04/07/2015 : **5.4J** CT [9 - 13]
04/07/2015 : **3.8J** CT [12 - 13]
04/29/2015 : **2.5** CT [13 - 14]
04/29/2015 : **4.6** CT [14 - 15]
04/29/2015 : **3.2J** CT [15 - 16]

George Road

South Service Road

069MW-009

72-1048-RV5-SB2
12/03/2012 : **14J** CT [5 - 6]

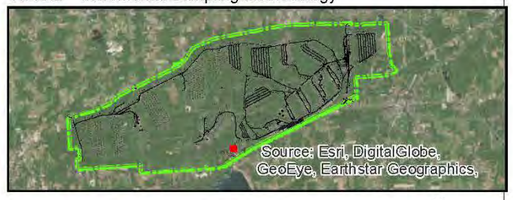
(2012)

Location ID — 69-1048-DU1-SB2
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)

Legend

- Installation Boundary
- 2018 Groundwater Monitoring Well Location
- Former UST RV-5 (100-gallon gasoline tank)
- 2012 CC RVAAP-72 SI Direct Push Boring Not Analyzed for VOCs
- 2012 Direct Push Boring Location
- 2015 Field Change Notice Subsurface Soil Boring
- 2018 Subsurface Soil Boring
- Decision Unit
- Cross-Section Trace
- Elevation contour (ft)
- Fence Line
- Former Structures
- 0.7 J — Concentration Exceeds Most Stringent EPA RSL for Resident Soil (TR=1E-06/THQ=0.1) of 0.65 mg/kg
- ISM Horizontal Sample for Decision Unit

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride at each previous sampling location. There is not a FWCUG for carbon tetrachloride in soil; therefore, carbon tetrachloride concentrations in soil were compared to the lower of the November 2018 EPA RSL for Resident Soil at the 10^{-6} target cancer risk level and non-carcinogenic target hazard quotient using the 0.1 risk. Concentrations which exceed the most stringent RSL are in **RED**
   EPA Residential RSL for carbon tetrachloride is 0.65 mg/kg.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. ISM = Incremental Sampling Methodology



N

0 40 Feet

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT
DRAWN BY: LH
CHECKED BY: EH
SUBMITTED BY: EH

Figure 2

Soil Sample Results
CC RVAAP-69 Building 1048 Fire Station
Carbon Tetrachloride Detections

SCALE: As Shown
PROJECT NUMBER: 640030.0005.110051
DATE: 4/15/2019
FILE:
FIGURE NUMBER: 2

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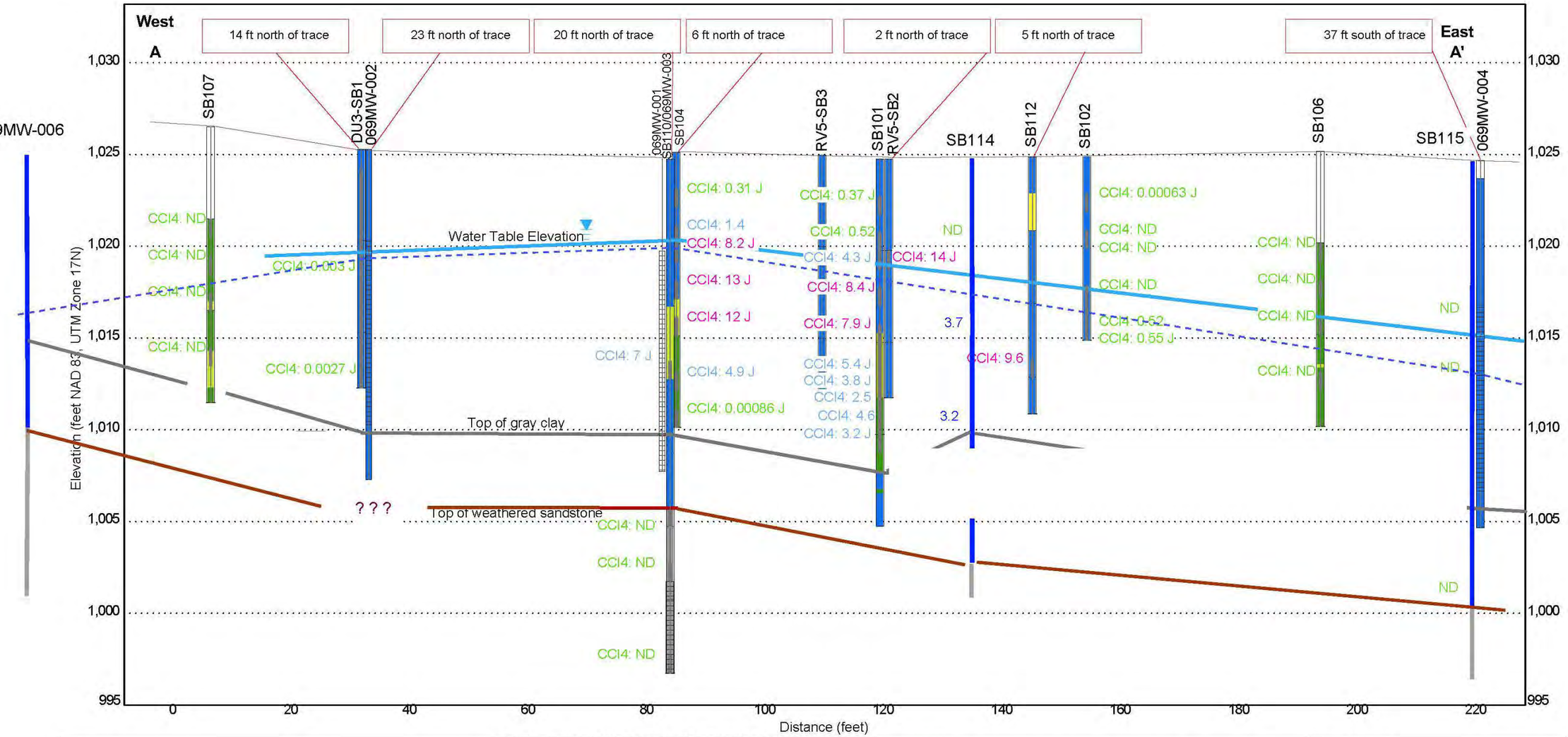


LEGEND

- GROUND SURFACE ELEVATION (feet NAD 83, UTM Zone 17N)
- SB101 — SAMPLE LOCATION
- SAMPLE INTERVAL (feet)
- Water Table Elevation (feet) March 2018
- SCREEN INTERVAL (feet)
- Water Table December 2018

SOIL LITHOLOGY AND HYDRAULIC CONDUCTIVITY RANGES

RELATIVE PERMEABILITY

- SP: 2.55 x 10^{-3} to 5.35 x 10^{-2} cm/sec
- SM: 1 x 10^{-6} to 5 x 10^{-4} cm/sec
- SC: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- ML: 5 x 10^{-7} to 1 x 10^{-4} cm/sec
- CL: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- CH: 5 x 10^{-8} to 5 x 10^{-5} cm/sec
- SS: 3 x 10^{-8} to 6 x 10^{-4} cm/sec
- NO SAMPLE RECOVERY

NOTES:
Purple Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 100X analyte screening level).
Scarlet Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 10X analyte screening level).
Blue Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (1 to 10X analyte screening level).
Green Label = Sample Does Not Exceed Cleanup Goal (0.65 mg/kg).
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
CCl4= Carbon Tetrachloride
ND = Not detected.
NA=Not available.
NAD 83 = UTM Zone 17N.
DU=Decision Unit
RVAAP= Ravenna Army Ammunition Plant
ft=feet
SB=Soil Boring
*72-1048-RV5-SB2 was collected in the location of 69-1048-SB101
**69-1048-DU3-SB1 was collected using Incremental Sampling Methodology.

FIGURE 3

CC RVAAP-69 Building 1048 Fire Station

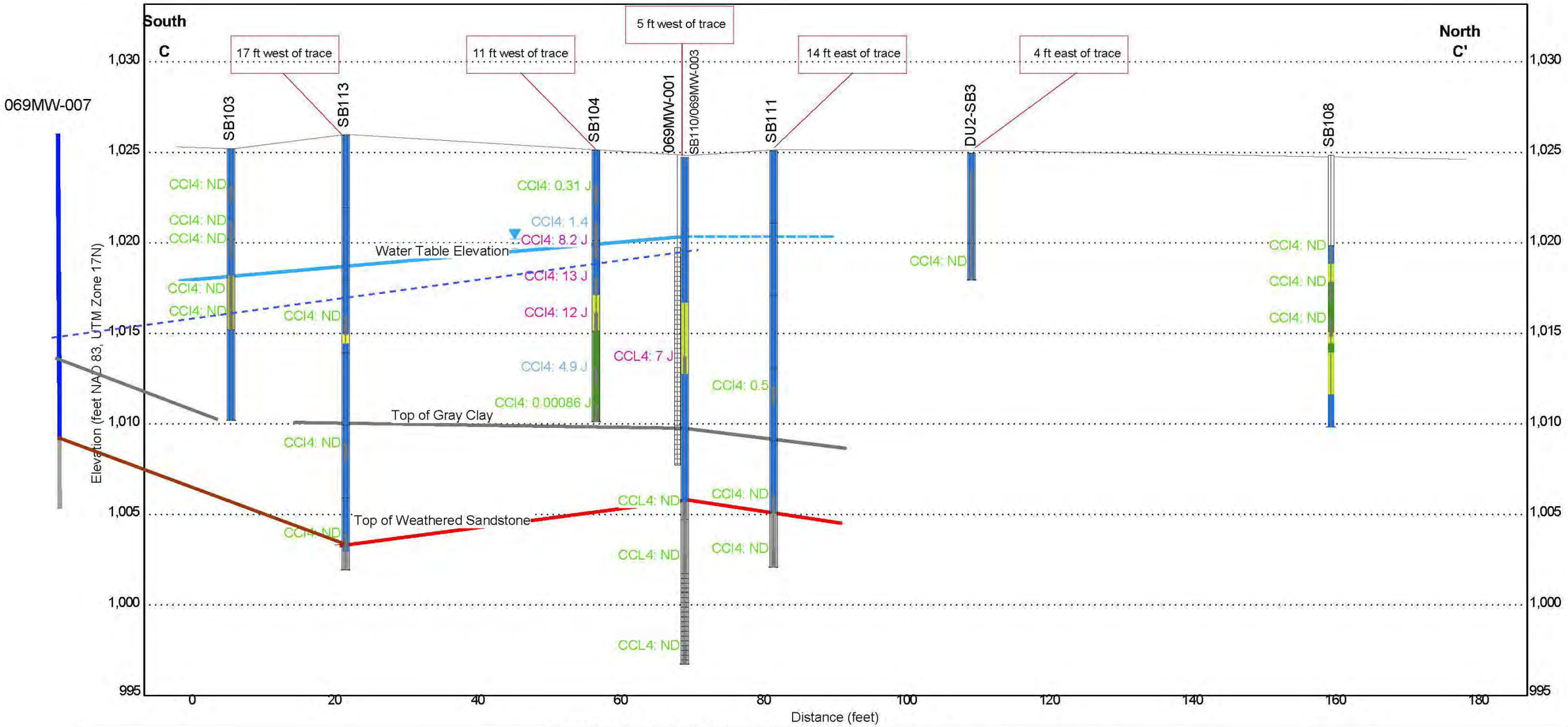
Cross Section A-A'

Mark-up with 12/2018 boring logs

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

P A R S O N S

\\CODEN10FS01\PRJDATA\ES\REMED\748917 GALENA FOL\03000 FIELD WORK\GINT LIBRARY (LOGS)\OFFICIAL GINT FILES\GALENA FENCE\MASTER DATABASE\GINT_GALENA_AMENDED_ALL (2).GPJ;



LEGEND

GROUND SURFACE ELEVATION (feet NAD 83, UTM Zone 17N)

SB108 SAMPLE LOCATION

SAMPLE INTERVAL (feet)

WATER TABLE ELEVATION (feet) March 2018

SCREEN INTERVAL (feet)

Water Table December 2018

SOIL LITHOLOGY AND HYDRAULIC CONDUCTIVITY RANGES

RELATIVE PERMEABILITY

- SP: 2.55 x 10^{-3} to 5.35 x 10^{-2} cm/sec
- SM: 1 x 10^{-5} to 5 x 10^{-4} cm/sec
- SC: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- ML: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- CL: 5 x 10^{-6} to 5 x 10^{-6} cm/sec
- CH: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- SS: 3 x 10^{-8} to 6 x 10^{-4} cm/sec
- NO SAMPLE RECOVERY

NOTES:
Purple Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 100X analyte screening level).
Scarlet Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 10X analyte screening level).
Blue Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (1 to 10X analyte screening level).
Green Label = Sample Does Not Exceed Cleanup Goal (0.65 mg/kg).
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
CCl4= Carbon Tetrachloride
ND = Not detected.
NA=Not available.
NAD 83 = UTM Zone 17N.
DU=Decision Unit
RVAAP= Ravenna Army Ammunition Plant
ft=feet
SB=Soil Boring

FIGURE 4

CC RVAAP-69 Building 1048 Fire Station

Cross Section C-C'

Mark-up with 12/2018 boring logs

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

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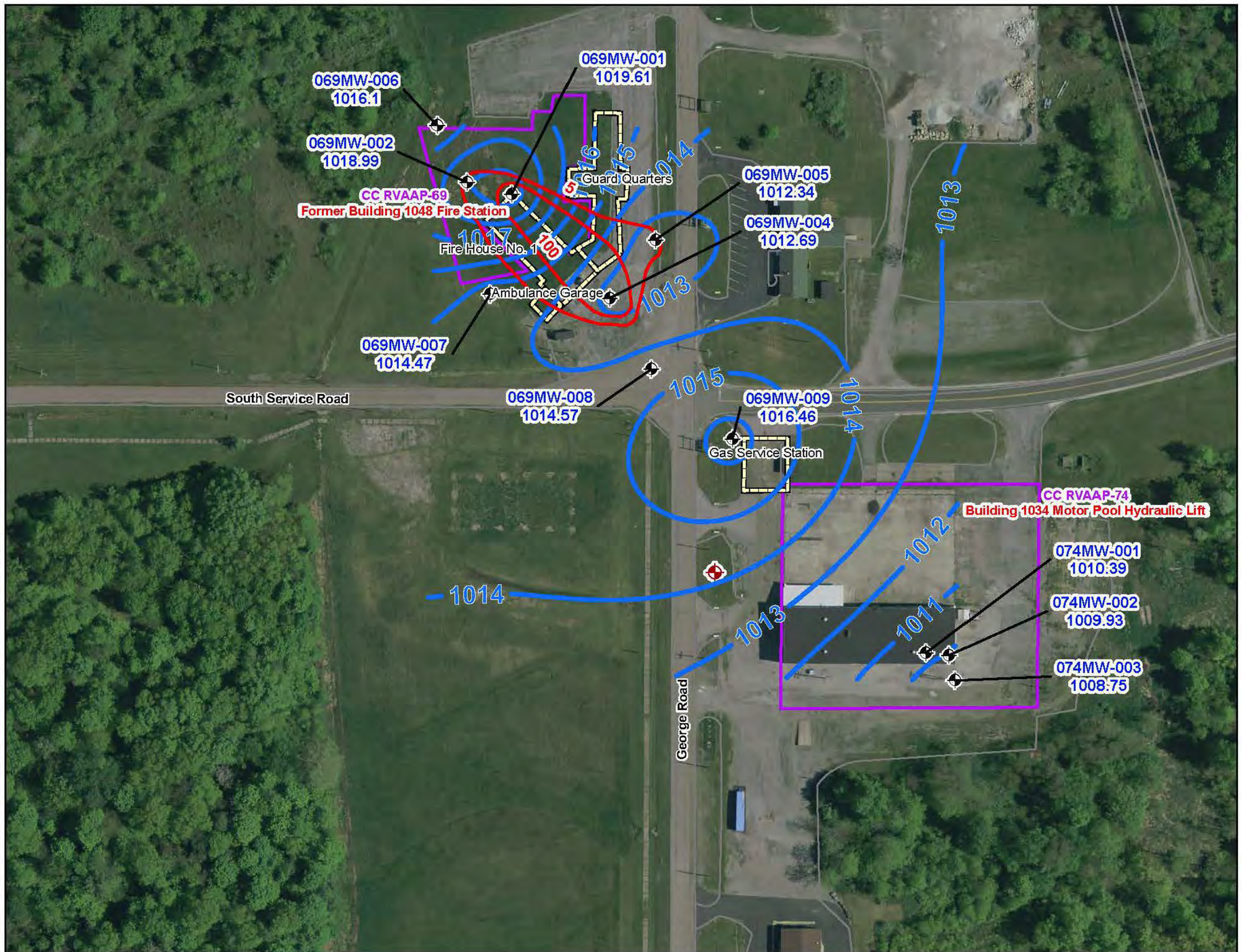
PARSONS



LEGEND

- Groundwater Monitoring Well
- Potentiometric Surface at March 7 - 8, 2019
- Carbon tetrachloride concentration contour (dashed where inferred)
- Inactive Groundwater Supply Well
- Former Structure
- Area of Concern
- Road

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N, 2014 Orthoimagery.
2. Contour Elevations in Feet.
3. RVAAP = Ravenna Army Ammunition Plant
4. CC = Army Environmental Compliance-Related Cleanup Program

0 100 Feet

N

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

Figure 5
Potentiometric Surface
March 2019
CC RVAAP-69 Building 1048 Fire Station
CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift

SCALE: As Shown	PROJECT NUMBER: 640030.0002.110051	
DATE: 4/16/2019	FIGURE NUMBER:	5
FILE:		

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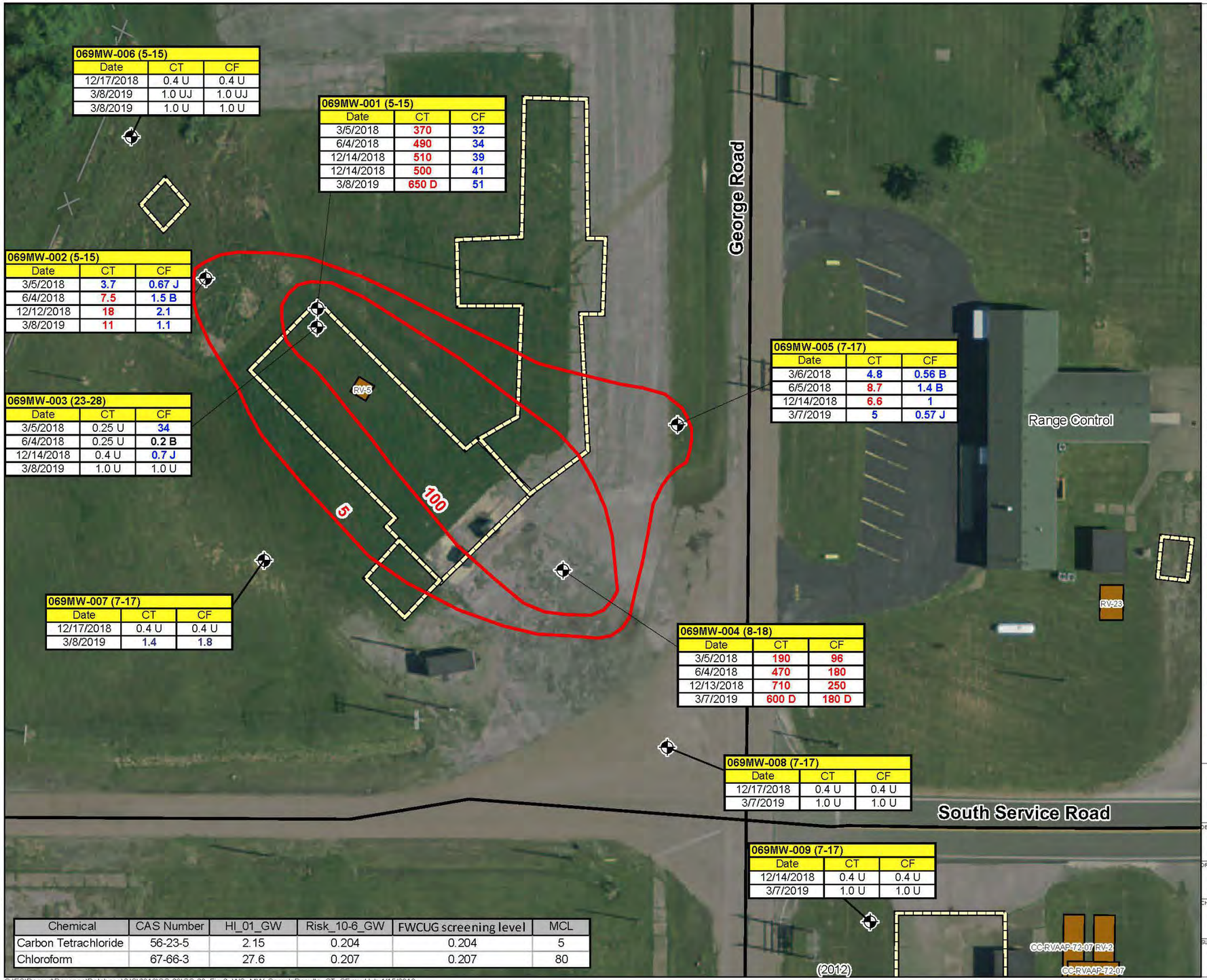

069MW-006 (5-15)

Date	CT	CF
12/17/2018	0.4 U	0.4 U
3/8/2019	1.0 UJ	1.0 UJ
3/8/2019	1.0 U	1.0 U

069MW-001 (5-15)

Date	CT	CF
3/5/2018	370	32
6/4/2018	490	34
12/14/2018	510	39
12/14/2018	500	41
3/8/2019	650 D	51

069MW-002 (5-15)

Date	CT	CF
3/5/2018	3.7	0.67 J
6/4/2018	7.5	1.5 B
12/12/2018	18	2.1
3/8/2019	11	1.1

069MW-003 (23-28)

Date	CT	CF
3/5/2018	0.25 U	34
6/4/2018	0.25 U	0.2 B
12/14/2018	0.4 U	0.7 J
3/8/2019	1.0 U	1.0 U

069MW-005 (7-17)

Date	CT	CF
3/6/2018	4.8	0.56 B
6/5/2018	8.7	1.4 B
12/14/2018	6.6	1
3/7/2019	5	0.57 J

069MW-007 (7-17)

Date	CT	CF
12/17/2018	0.4 U	0.4 U
3/8/2019	1.4	1.8

069MW-004 (8-18)

Date	CT	CF
3/5/2018	190	96
6/4/2018	470	180
12/13/2018	710	250
3/7/2019	600 D	180 D

069MW-008 (7-17)

Date	CT	CF
12/17/2018	0.4 U	0.4 U
3/7/2019	1.0 U	1.0 U

069MW-009 (7-17)

Date	CT	CF
12/14/2018	0.4 U	0.4 U
3/7/2019	1.0 U	1.0 U

Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Legend

- Installation Boundary
- 2018 Groundwater Monitoring Well Location
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2014 Orthoimagery.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater samples at each groundwater sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=$10^{-6}$and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in micrograms per liter (ug/L)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal

N

0 40 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT
DRAWN BY: LH
CHECKED BY: EH
SUBMITTED BY: EH

Figure 6

Groundwater Monitoring Wells
CC RVAAP-69 Building 1048 Fire Station

SCALE: As Shown
DATE: April, 2019
FILE:
PROJECT NUMBER: 640030.0005.110051
FIGURE NUMBER: 6

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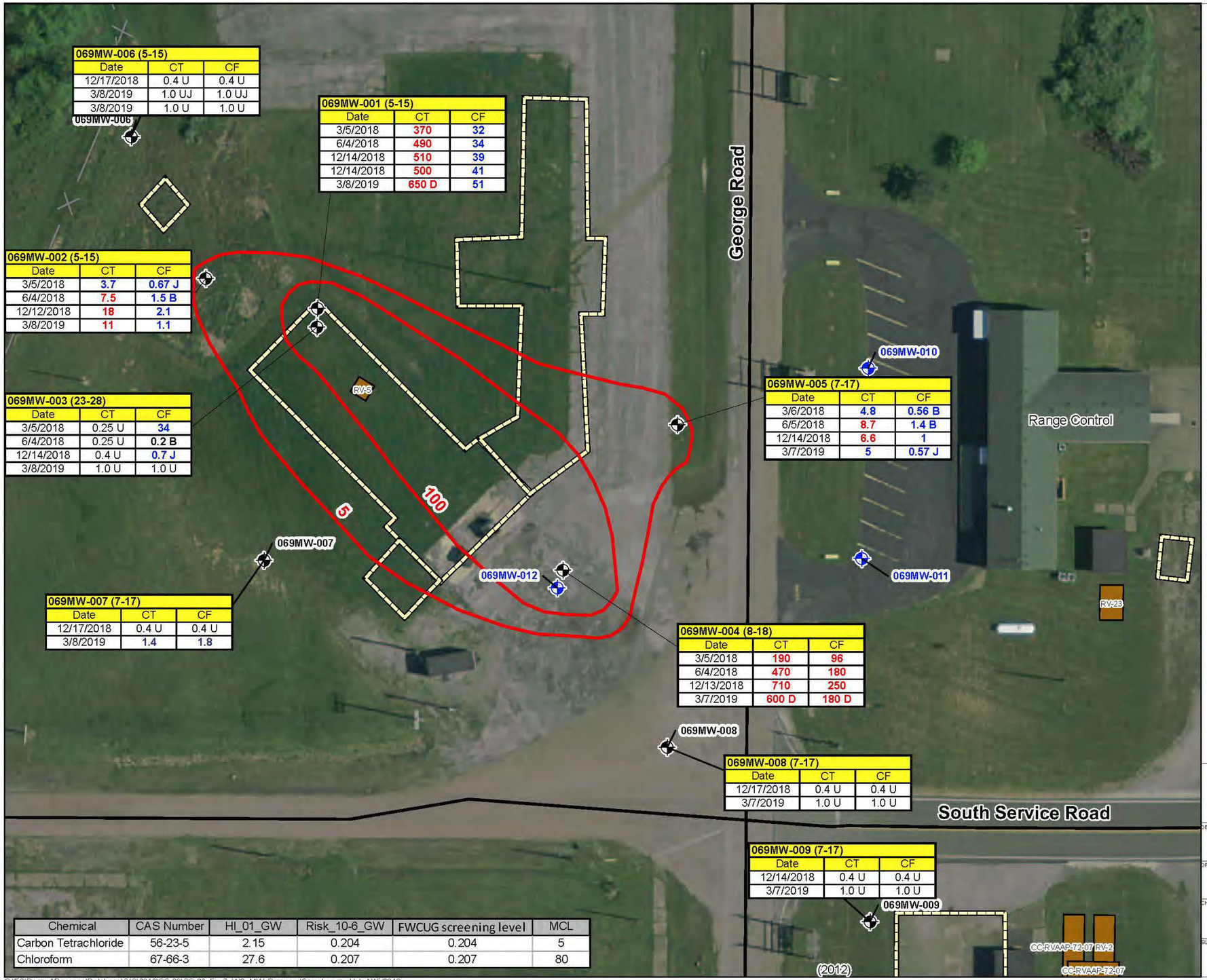

Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Legend

- Installation Boundary
- 2018 Groundwater Monitoring Well Location
- Proposed Groundwater Monitoring Wells
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2014 Orthoimagery.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater samples at each groundwater sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=10^{-6} and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in micrograms per liter (ug/L)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal

N

0 40 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT
DRAWN BY: LH
CHECKED BY: EH
SUBMITTED BY: EH

Figure 7

Proposed Groundwater Monitoring Wells CC RVAAP-69 Building 1048 Fire Station

SCALE: As Shown
DATE: April, 2019
FILE:
PROJECT NUMBER: 640030.0005.110051
FIGURE NUMBER: 7

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Table 1
Results of 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		Resident Soil RSL (a)	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location			69-1048-SB110	69-1048-SB110	69-1048-SB110	69-1048-SB110	69-1048-SB110
Field Sample ID			069SB-110-0088-SO	069SB-110-9088-SO	069SB-110-0089-SO	069SB-110-0090-SO	069SB-111-0096-SO
Lab Sample ID			160-26664-1	160-26664-2	160-26664-3	160-26664-4	160-26664-5
Sample Date			2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018
Sample Interval (feet bgs)			11-12	11-12	19-20	22-23	27-28
Sample Type			N	FD	N	N	N
Chemical	**CAS Number**						
Volatile Organic Compounds (mg/kg)							
Carbon tetrachloride	56-23-5	0.65	**4.9**	**7 J**	0.0008 U	0.0009 U	0.00084 U
Chloroform	67-66-3	0.32	**0.037**	**0.05 J**	0.0008 U	0.0009 U	0.00084 U
Methylene Chloride	75-09-2	35	0.0049 U	0.0043 U	0.004 U	0.0045 U	0.0042 U
Chloromethane	74-87-3	11	0.0049 U	0.0043 U	0.004 U	0.0045 U	0.0042 U

Table 1
Results of 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		Resident Soil RSL (a)	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location			69-1048-SB111	69-1048-SB111	69-1048-SB111	69-1048-SB112	69-1048-SB112
Field Sample ID			069SB-111-0096-SO	069SB-111-0097-SO	069SB-111-0098-SO	069SB-112-0099-SO	069SB-112-9099-SO
Lab Sample ID			160-26664-6	160-26664-7	160-26664-8	160-26664-9	160-26664-10
Sample Date			2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018
Sample Interval (feet bgs)			13-14	19-20	22-23	11-12	11-12
Sample Type			N	N	N	N	FD
Chemical	**CAS Number**						
Volatile Organic Compounds (mg/kg)							
Carbon tetrachloride	56-23-5	0.65	**0.5**	0.00088 U	0.00089 U	**7.7 J**	**9.6**
Chloroform	67-66-3	0.32	**0.059 J**	0.00088 U	0.00089 U	**0.1 J**	**0.098 J**
Methylene Chloride	75-09-2	35	**0.0033 J**	0.0044 U	0.0044 U	0.0046 U	0.0043 U
Chloromethane	74-87-3	11	0.004 U	0.0044 U	0.0044 U	0.0046 U	0.0043 U

Table 1
Results of 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		Resident Soil RSL (a)	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location			69-1048-SB113	69-1048-SB113	69-1048-SB113	69-1048-SB114	69-1048-SB114
Field Sample ID			069SB-113-0102-SO	069SB-113-0103-SO	069SB-113-0104-SO	069SB-114-0105-SO	069SB-114-0106-SO
Lab Sample ID			160-26664-12	160-26664-13	160-26664-14	320-45823-1	320-45823-2
Sample Date			2/6/2018	2/6/2018	2/6/2018	12/4/2018	12/4/2018
Sample Interval (feet bgs)			10-11	17-18	22-23	4-5	9-10
Sample Type			N	N	N	N	N
Chemical	**CAS Number**						
Volatile Organic Compounds (mg/kg)							
Carbon tetrachloride	56-23-5	0.65	0.00086 U	0.00084 U	0.00096 U	0.0021 U	**3.7 J**
Chloroform	67-66-3	0.32	0.00086 U	0.00084 U	0.00096 U	0.0011 U	**0.072 J**
Methylene Chloride	75-09-2	35	0.0043 U	0.0042 U	0.0048 U	**0.0011 J**	**0.051 J**
Chloromethane	74-87-3	11	0.0043 U	0.0042 U	0.0048 U	0.0011 U	0.013 U

Table 1
Results of 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		Resident Soil RSL (a)	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location			69-1048-SB114	69-1048-SB114	69-1048-SB114	69-1048-SB115	69-1048-SB115
Field Sample ID			069SB-114-0107-SO	069SB-114-9107-SO	069SB-114-0108-SO	069SB-115-0109-SO	069SB-115-0110-SO
Lab Sample ID			320-45823-3	320-45823-4	320-45823-5	320-45823-6	320-45823-7
Sample Date			12/4/2018	12/4/2018	12/4/2018	12/4/2018	12/4/2018
Sample Interval (feet bgs)			14-15	14-15	19-20	7-8	11-12
Sample Type			N	FD	N	N	N
Chemical	**CAS Number**						
Volatile Organic Compounds (mg/kg)							
Carbon tetrachloride	56-23-5	0.65	**3.2**	**1.9 J**	0.0017 U	0.0018 U	0.0018 U
Chloroform	67-66-3	0.32	**0.55 J**	**0.28 J**	0.00087 U	0.00088 U	0.00092 U
Methylene Chloride	75-09-2	35	**0.027 J**	**0.005 J**	**0.0017 J**	0.0018 U	**0.0012 J**
Chloromethane	74-87-3	11	0.014 U	0.0063 U	0.00087 U	0.00088 U	0.00092 U

Table 1
Results of 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		Resident Soil RSL [(a)]	CC RVAAP-69	CC RVAAP-69
Sample Location			69-1048-SB115	69-1048-SB115
Field Sample ID			069SB-115-0111-SO	069SB-115-0112-SO
Lab Sample ID			320-45823-8	320-45823-9
Sample Date			12/4/2018	12/4/2018
Sample Interval (feet bgs)			18-19	22-23
Sample Type			N	N
Chemical	**CAS Number**			
Volatile Organic Compounds (mg/kg)				
Carbon tetrachloride	56-23-5	0.65	0.0018 U	0.0017 UJ
Chloroform	67-66-3	0.32	0.00089 U	0.00087 UJ
Methylene Chloride	75-09-2	35	**0.0033 J**	**0.0017 J**
Chloromethane	74-87-3	11	0.00089 U	0.00087 UJ

Notes:
BOLD = chemical detected
Concentration exceeds the November 2018 EPA Resident Soil RSL.
[(a)] There is not a FWCUG in soil; therefore, concentrations in soil were compared to the lower of the November 2018 EPA RSL for Resident Soil at the 10^{-6} target cancer risk level and non-carcinogenic target hazard quotient using the 0.1 risk.
FD = field duplicate
mg/kg = milligrams per kilogram

Table 2
Groundwater Elevation Data
CC RVAAP-69 Building 1048 Fire Station and CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift

Well Station ID	Top of PVC (ft amsl)	March 2018 Monitoring Event			June 2018 Monitoring Event			September 2018 Monitoring Event		
		Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)	Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)	Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)
CC RVAAP-69										
069MW-001	1027.25	3/5/2018	6.97	1020.28	6/4/2018	8.42	1018.83	9/5/2018	14.01	1013.24
069MW-002	1028.28	3/5/2018	8.77	1019.51	6/4/2018	11.05	1017.23	9/5/2018	15.26	1013.02
069MW-003 [(a)]	1027.28	3/5/2018	14.16	1013.12	6/4/2018	14.81	1012.47	9/5/2018	17.39	1009.89
069MW-004	1024.19	3/5/2018	8.77	1015.42	6/4/2018	11.25	1012.94	9/5/2018	12.45	1011.74
069MW-005	1023.18	3/6/2018	7.91	1015.27	6/5/2018	10.82	1012.36	9/5/2018	11.02	1012.16
069MW-006	1028.39	-	-	-	-	-	-	-	-	-
069MW-007	1029.35	-	-	-	-	-	-	-	-	-
069MW-008 [(b)]	1023.87	-	-	-	-	-	-	-	-	-
069MW-009	1023.54	-	-	-	-	-	-	-	-	-
CC RVAAP-74										
074MW-001	1022.01	3/6/2018	11.99	1010.02	6/5/2018	11.60	1010.41	9/5/2018	12.81	1009.20
074MW-002	1021.64	3/6/2018	12.42	1009.22	6/5/2018	11.70	1009.94	9/5/2018	13.12	1008.52
074MW-003	1020.81	3/6/2018	12.98	1007.83	6/5/2018	12.53	1008.28	9/5/2018	14.15	1006.66

Table 2
Groundwater Elevation Data
CC RVAAP-69 Building 1048 Fire Station and CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift

Well Station ID	Top of PVC (ft amsl)	December 2018 Pre-Development			December 2018 Monitoring Event			March 2019 Monitoring Event		
		Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)	Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)	Date	Depth to Water (ft bgs)	Water Elevation (ft amsl)
CC RVAAP-69										
069MW-001	1027.25	-	-	-	12/14/2018	7.58	1019.67	3/8/2018	7.64	1019.61
069MW-002	1028.28	-	-	-	12/12/2018	9.12	1019.16	3/8/2018	9.29	1018.99
069MW-003 [(a)]	1027.28	-	-	-	12/14/2018	14.48	1012.8	3/8/2018	14.05	1013.23
069MW-004	1024.19	-	-	-	12/13/2018	11.32	1012.87	3/7/2018	11.5	1012.69
069MW-005	1023.18	-	-	-	12/14/2018	10.58	1012.6	3/7/2018	10.84	1012.34
069MW-006	1028.39	12/10/2018	12.32	1016.07	12/17/2018	12.31	1016.08	3/8/2018	12.29	1016.1
069MW-007	1029.35	12/10/2018	14.59	1014.76	12/17/2018	15.02	1014.33	3/8/2018	14.88	1014.47
069MW-008 [(b)]	1023.87	12/10/2018	11.61	1012.26	12/17/2018 [(b)]	13.23	1010.64	3/7/2018	9.30	1014.57
069MW-009	1023.54	12/10/2018	8.02	1015.52	12/14/2018	8.11	1015.43	3/7/2018	7.08	1016.46
CC RVAAP-74										
074MW-001	1022.01	-	-	-	12/13/2018	12.01	1010.00	3/7/2018	11.62	1010.39
074MW-002	1021.64	-	-	-	12/13/2018	12.29	1009.35	3/7/2018	11.71	1009.93
074MW-003	1020.81	-	-	-	12/13/2018	13.29	1007.52	3/7/2018	12.06	1008.75

Notes:
[(a)] Well 069MW-003 screened 23-28 ft bgs in weathered sandstone
All other wells screened in overburden material above (sometimes crossing into) gray clay layer
[(b)] Well 069MW-008 was slow to recharge during development. 12/17/18 water level may not be representative.
ft amsl = feet above mean sea level
ft bgs = feet below ground surface

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG		CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	
Sample Location		Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)		069MW-001	069MW-001	069MW-001	069MW-001	
Field Sample ID				069MW-001-0001-GW	069MW-001-0002-GW	069MW-001-0003-GW	069MW-001-9003-GW	
Lab Sample ID				160-27124-2	160-28791-2	320-46191-2	320-46191-3	
Sample Date				3/5/2018	6/4/2018	12/14/2018	12/14/2018	
Sample Interval (feet bgs)				5-15	5-15	5-15	5-15	
Sample Type				N	N	N	FD	
Chemical	**CAS Number**		**MCL**					
Carbon tetrachloride	56-23-5	0.204	5	**370**	**490**	**510**	**500**	**650**
Chloroform	67-66-3	0.207	80	**32**	**34**	**39**	**41**	**51**
Methylene Chloride	75-09-2	5.34	5	**1.9 J**	1.3 U	16 U	16 U	3.5 U
Chloromethane	74-87-3	19 [(a)]	-	0.63 U	0.63 U	16 U	16 U	15 U

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)	MCL	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location				069MW-002	069MW-002	069MW-002	069MW-002	069MW-003
Field Sample ID				069MW-002-0001-GW	069MW-002-0002-GW	069MW-002-0003-GW	069MW-002-0004-GW	069MW-003-0001-GW
Lab Sample ID				160-27124-3	160-28791-3	320-46168-1	320-48218-5	160-27124-4
Sample Date				3/5/2018	6/4/2018	12/12/2018	3/8/2019	3/5/2018
Sample Interval (feet bgs)				5-15	5-15	5-15	5-15	23-28
Sample Type				N	N	N	N	N
Chemical	**CAS Number**							
Volatile Organic Compounds (µg/L)								
Carbon tetrachloride	56-23-5	0.204	5	**3.7**	**7.5**	**18**	**11**	0.25 U
Chloroform	67-66-3	0.207	80	**0.67 J**	**1.5 B**	**2.1**	**1.1**	**34**
Methylene Chloride	75-09-2	5.34	5	0.5 U	0.5 U	0.8 U	3.5 U	**15**
Chloromethane	74-87-3	19 [(a)]	-	0.25 U	0.25 U	0.8 U	15 U	0.25 U

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)	MCL	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location				069MW-003	069MW-003	069MW-003	069MW-004	069MW-004
Field Sample ID				069MW-003-0002-GW	069MW-003-0003-GW	069MW-003-0004-GW	069MW-004-0001-GW	069MW-004-0002-GW
Lab Sample ID				160-28791-4	320-46191-4	320-48218-3	160-27124-5	160-28791-5
Sample Date				6/4/2018	12/14/2018	3/8/2019	3/5/2018	6/4/2018
Sample Interval (feet bgs)				23-28	23-28	23-28	8-18	8-18
Sample Type				N	N	N	N	N
Chemical	**CAS Number**							
Volatile Organic Compounds (µg/L)								
Carbon tetrachloride	56-23-5	0.204	5	0.25 U	0.4 U	1 U	**190**	**470**
Chloroform	67-66-3	0.207	80	**0.2 B**	**0.7 J**	1 U	**96**	**180**
Methylene Chloride	75-09-2	5.34	5	0.5 U	0.8 U	3.5 U	**0.47 J**	1.3 U
Chloromethane	74-87-3	19 [(a)]	-	0.25 U	0.8 U	15 U	0.25 U	0.63 U

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)	MCL	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location				069MW-004	069MW-004	069MW-005	069MW-005	069MW-005
Field Sample ID				069MW-004-0003-GW	069MW-004-0004-GW	069MW-005-0001-GW	069MW-005-0002-GW	069MW-005-0003-GW
Lab Sample ID				320-46168-2	320-48202-5	160-27124-6	160-28791-6	320-46191-5
Sample Date				12/13/2018	3/7/2019	3/6/2018	6/5/2018	12/14/2018
Sample Interval (feet bgs)				8-18	8-18	7-17	7-17	7-17
Sample Type				N	N	N	N	N
Chemical	**CAS Number**							
Volatile Organic Compounds (µg/L)								
Carbon tetrachloride	56-23-5	0.204	5	**710**	**600**	**4.8**	**8.7**	**6.6**
Chloroform	67-66-3	0.207	80	**250**	**180**	**0.56 B**	**1.4 B**	**1**
Methylene Chloride	75-09-2	5.34	5	16 U	3.5 U	0.5 U	0.5 U	0.8 U
Chloromethane	74-87-3	19 [(a)]	-	16 U	15 U	0.25 U	0.25 U	0.8 U

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)	MCL	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location				069MW-005	069MW-006	069MW-006	069MW-006	069MW-007
Field Sample ID				069MW-005-0004-GW	069MW-006-0001-GW	069MW-006-0002-GW	069MW-006-9002-GW	069MW-007-0001-GW
Lab Sample ID				320-48202-4	320-46222-2	320-48218-6	320-48218-7	320-46222-3
Sample Date				3/7/2019	12/17/2018	3/8/2019	3/8/2019	12/17/2018
Sample Interval (feet bgs)				7-17	5-15	5-15	5-15	7-17
Sample Type				N	N	N	FD	N
Chemical	**CAS Number**							
Volatile Organic Compounds (µg/L)								
Carbon tetrachloride	56-23-5	0.204	5	**5**	0.4 U	1 UJ	1 U	0.4 U
Chloroform	67-66-3	0.207	80	**0.57 J**	0.4 U	1 UJ	1 U	0.4 U
Methylene Chloride	75-09-2	5.34	5	3.5 U	0.8 U	3.5 R	3.5 U	0.8 U
Chloromethane	74-87-3	19 [(a)]	-	15 U	0.8 U	15 R	15 U	0.8 U

Table 3
Results of 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		FWCUG Resident Receptor (Lowest of Adult or Child, Risk = 10^{-6} and HQ = 0.1)	MCL	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location				069MW-007	069MW-008	069MW-008	069MW-009	069MW-009
Field Sample ID				069MW-007-0002-GW	069MW-008-0001-GW	069MW-008-0002-GW	069MW-009-0001-GW	069MW-009-0002-GW
Lab Sample ID				320-48218-2	320-46222-4	320-48202-2	320-46191-6	320-48202-3
Sample Date				3/8/2019	12/17/2018	3/7/2019	12/14/2018	3/7/2019
Sample Interval (feet bgs)				7-17	7-17	7-17	7-17	7-17
Sample Type				N	N	N	N	N
Chemical	**CAS Number**							
Volatile Organic Compounds (µg/L)								
Carbon tetrachloride	56-23-5	0.204	5	**1.4**	0.4 U	1 U	0.4 U	1 U
Chloroform	67-66-3	0.207	80	**1.8**	0.4 U	1 U	0.4 U	1 U
Methylene Chloride	75-09-2	5.34	5	3.5 U	0.8 U	3.5 U	0.8 U	3.5 U
Chloromethane	74-87-3	19 [(a)]	-	15 U	0.8 U	15 U	0.8 U	15 U

Notes:
BOLD = chemical detected
Concentration exceeds lowest FWCUG screening level.
Concentration exceeds MCL
[(a)] November 2018 Residential Tap Water RSL, lower of HQ=0.1 and ELCR=1 x 10^{-6}. Only shown if there is no Groundwater FWCUG.
FWCUG = Facility-Wide Cleanup Goal
MCL = Safe Drinking Water Act Maximum Contaminant Level
µg/L = micrograms per liter
FD = field duplicate
feet bgs = feet below ground surface

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PARSONS

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
069MW-001

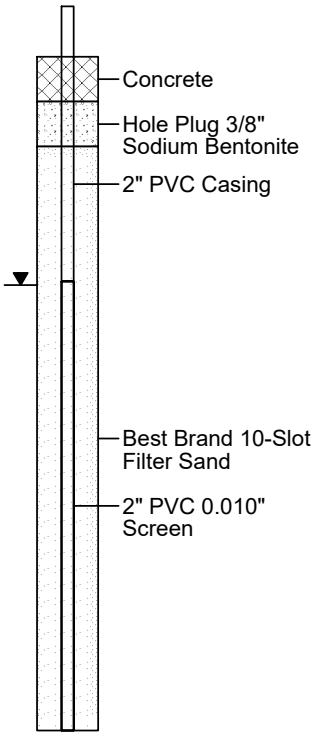
Start Date	: 8 February 2018
End Date	: 8 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551524.76
Easting Coord.	: 2357766.03
Total Depth of Boring	: 15.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	10YR3/3 Brown, moist, CLAY, silt, sand, trace gravel.		
2		100					
3	2			0.0			
4							
5	3			0.0	Wet at approximately 5'		
6		100				CL	
7	4			0.0			
8							
9	5			0.0			
10		90					
11	6			0.0			
12							
13	7			0.0	10YR3/1 Gray, moist to wet, CLAY, silt, sand, trace gravel.		
14		100				CL	
15	8			0.0			

End of boring at 15.0'.
Notes:
Ground Surface Elevation: 1024.69
Well riser: Extends 2.56' above surface elevation

Well: 069MW-001
TOC Elev.: 1027.25



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CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

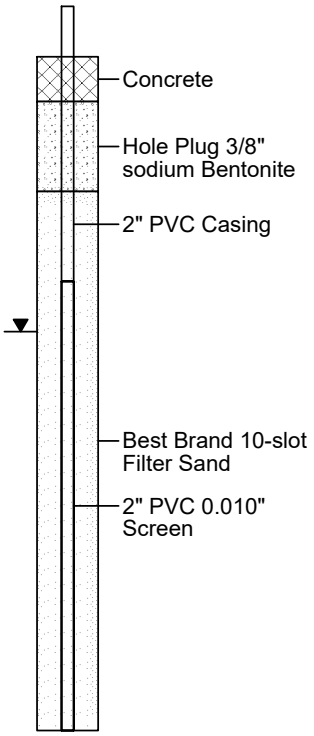
CC RVAAP-69
069MW-002

Start Date	: 12 February 2018
End Date	: 12 February 2018
Weather	: 10 F/Clear
Northing Coord.	: 551537.19
Easting Coord.	: 2357718.33
Total Depth of Boring	: 16.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	10YR3/3 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.		
2		100					
3	2			0.0			
4							
5	3			0.0	Wet at approximately 5'		
6		100				CL	
7	4			0.0			
8							
9	5			0.0			
10		100					
11	6			0.0			
12					10YR5/1 Gray, moist, CLAY, silt, sand, trace gravel.		
13	7			0.0			
14		100				CL	
15	8			0.0			
16					End of boring at 16.0'.		
17					Notes:		
18					Ground Surface Elevation: 1025.11		
19					Well Riser: Extends 3.17' above surface elevation		
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Well: 069MW-002
TOC Elev.: 1028.28



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CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
69-1048-SB110/069MW-003

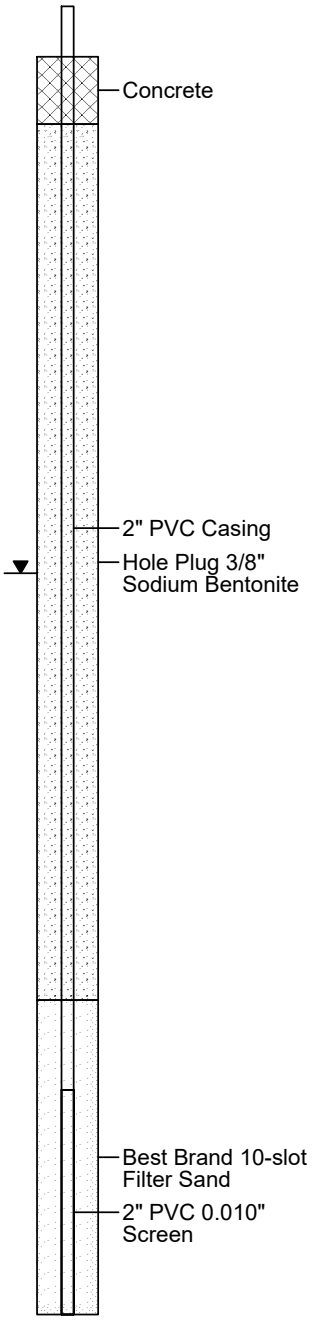
Start Date	: 6 February 2018 (Boring)
End Date	: 14 February 2018 (Well)
Weather	: 10 F/Snow
Northing Coord.	: 551516.85
Easting Coord.	: 2357765.97
Total Depth of Boring	: 28.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–8	1	100		0.0	10YR3/4 Brown, moist, slightly plastic, CLAY, silt, trace gravel.	CL	
	2			0.0			
	3			0.0			
	4	100		0.0			
8–12	5			0.0	10YR4/4 Brown, wet, SILTY SAND, with some clay.	SM	
	6	100	069SB-110-0088-SO	0.0			
12–16	7			0.0	10YR3/1 Brown grading to gray, slightly plastic, CLAY, silt, sand, with thin wet sandy layers.	CL	
	8	100		0.0			
16–19	9			0.0	10YR4/1 Gray, wet, CLAY, silt, sand.	CL	
	10	100	069SB-110-0089-SO	0.0			
19–28	11			0.0	Weathered SANDSTONE	SS	
	12	100	069SB-110-0090-SO	0.0			
	13			0.0			
	14	100	069SB-110-0091-SO	0.0			

Refusal at 28.0'.
Notes:
Ground Surface Elevation: 1024.73
Well Riser: Extends 2.55' above surface elevation

Well: 069MW-003
TOC Elev.: 1027.28



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CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

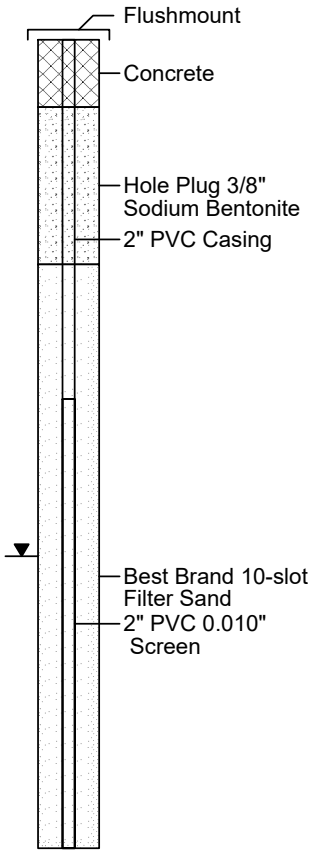
CC RVAAP-69
069MW-004

Start Date	: 20 February 2018
End Date	: 20 February 2018
Weather	: 60 F/Cloudy
Northing Coord.	: 551415.01
Easting Coord.	: 2357873.25
Total Depth of Boring	: 20.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5' zx 4' long acetate liner
	: 2' x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1			0.0	Degraded asphalt and gravel.	AR	
1–2		100			10YR5/4 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
2–3	2			0.0			
3–4							
4–5	3			0.0			
5–6		100					
6–7	4			0.0			
7–8							
8–9	5			0.0			
9–10		100					
10–11	6			0.0			
11–12					Wet		
12–13	7			0.0			
13–14		100					
14–15	8			0.0			
15–16							
16–17	9			0.0			
17–18		100					
18–19	10			0.0	10YR4/1 Gray, wet, CLAY, silt, sand.	CL	
19–20							
20–21					End of boring at 20.0'.		
21–22					Notes:		
22–23					Ground Surface Elevation: 1024.79		
23–24					Concrete Elevation: 1024.75		
24–25							
25–26							
26–27							
27–28							
28–29							
29–30							

Well: 069MW-004
TOC Elev.: 1024.19



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CC RVAAP-69 069MW-005

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

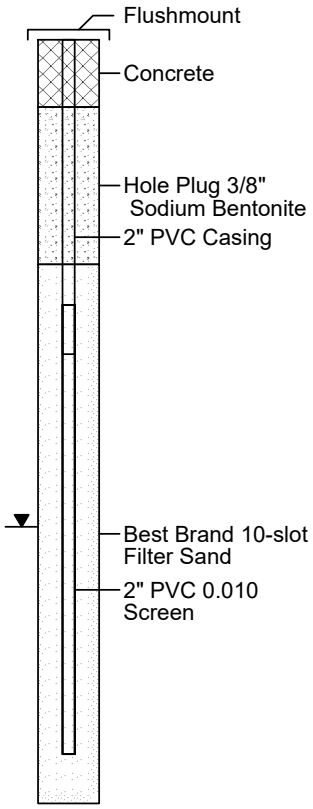
Start Date	: 20 February 2018
End Date	: 20 February 2018
Weather	: 60 F/Cloudy
Northing Coord.	: 551478.08
Easting Coord.	: 2357920.65
Total Depth of Boring	: 20.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1	90		0.0	Topsoil 10YR4/1 Brown, moist, CLAY, silt, sand, trace gravel.	CL	
1–2							
2–3	2			0.0			
3–4							
4–5	3			35.2			
5–6		100					
6–7	4			3.2			
7–8							
8–9	5			0.0			
9–10		100					
10–11	6			0.0	Wet		
11–12							
12–13	7			0.0			
13–14		100					
14–15	8			0.0	4" coarse SAND layer	SW	
15–16					10YR5/3 Brown, wet, CLAY, silt, sand, trace gravel.	CL	
16–17	9			0.0	10YR5/1 Gray, CLAY, silt, sand, trace gravel.		
17–18		100				CL	
18–19	10			0.0			
19–20							

End of boring at 20.0'.
Notes:
Ground Surface Elevation: 1023.84
Concrete Elevation: 1023.76

Well: 069MW-005
TOC Elev.: 1023.18



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CC RVAAP-69
069MW-006

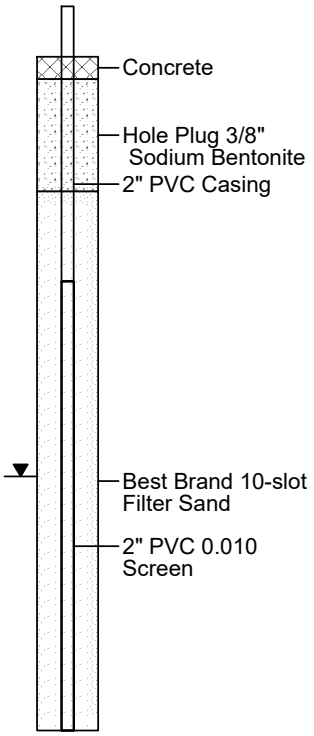
CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

Start Date	: 3 December 2018
End Date	: 3 December 2018
Weather	: 42 F/Cloudy
Northing Coord.	: 551597
Easting Coord.	: 2357685
Total Depth of Boring	: 20.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 4.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Grass and 4" organic layer.		
1	1			0.0	10YR4/4 Brown, moist, slightly plastic, SAND, silt, and clay. Trace gravel.		
2		100					
3	2			0.0			
4							
5	3			0.0		SP	
6		100					
7	4			0.0			
8							
9	5			0.0			
10		100					
11	6			0.0	10YR3/3 Gray, moist, slightly plastic, CLAY and silt.		
12							
13	7			0.0	10YR4/1 Gray, wet, slightly plastic, CLAY, silt, and sand.	CL	
14		100			10YR4/1 Gray, moist, slightly plastic, CLAY and silt.		
15	8			0.0			
16					10YR5/2 Brown, moist, slightly plastic, CLAY and silt.		
17	9			0.0		CL	
18		100					
19	10			0.0	10YR5/2 Brown, moist, SAND, silt, and gravel. Gravel contains coal fragments and rounded sandstone fragments.	SP	
20							
21					End of boring at 20.0'.		
22					Notes:		
23					Ground Surface Elevation: 1025.44		
24					Well Riser: Extends 2.95' above surface elevation		
25							
26							
27							
28							
29							
30							

Well: 069MW-006
TOC Elev.: 1028.39



PARSONS

CC RVAAP-69
069MW-007

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

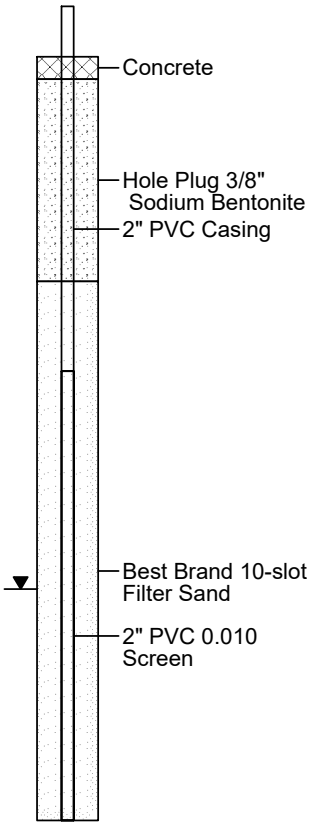
Start Date	: 3 December 2018
End Date	: 6 December 2018
Weather	: 42 F/Cloudy
Northing Coord.	: 551417
Easting Coord.	: 2357745
Total Depth of Boring	: 20.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 4.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1	100		0.0	Grass and 4" topsoil layer.		
1–2					10YR6/4 Brown, moist, plastic, CLAY and silt. Trace sand and gravel.	SP	
2–3	2			0.0			
3–4							
4–5	3			0.0			
5–6		100					
6–7	4			0.0			
7–8							
8–9	5			0.0			
9–10					Wet, SANDY CLAY and silt.	CL	
10–11	6	100		0.0	10YR5/3 Brown, moist, plastic, CLAY and silt. Trace sand and gravel.	CL	
11–12							
12–13	7			0.0	10YR5/1 Gray, moist, plastic, CLAY and silt. Trace sand.	CL	
13–14		100					
14–15	8			0.0			
15–16					Wet, CLAY, silt, and sand.		
16–17	9			0.0			
17–18		100					
18–19	10			0.0	Hard, brittle, 10YR4/1 gray, CLAY. May be weathered shale or shale fragments.	CL	
19–20							
20–30					End of boring at 20.0'.		

Notes:
Ground Surface Elevation: 1026.32
Well Riser: Extends 3.03' above surface elevation

Well: 069MW-007
TOC Elev.: 1029.35



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CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

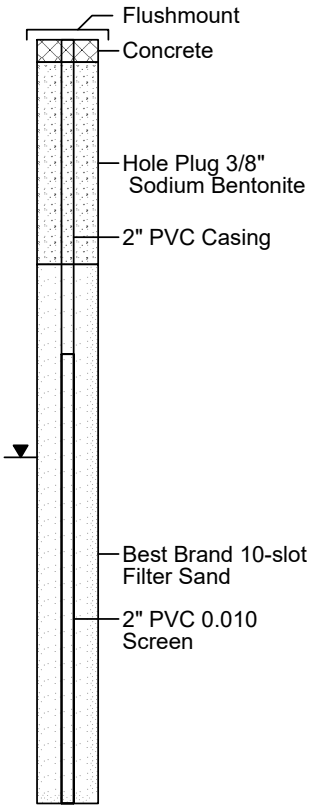
CC RVAAP-69
069MW-008

Start Date	: 4 December 2018
End Date	: 7 December 2018
Weather	: 31 F/Cloudy
Northing Coord.	: 551340
Easting Coord.	: 2357919
Total Depth of Boring	: 24.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 4.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Alphalt -6"	AR	
1	1			0.0	Gravel - 6"	GW	
2		100			10YR3/2 Brown, moist, slightly plastic, CLAY, silt, and sand.		
3	2			0.0			
4					10YR3/2 Brown, moist, slightly plastic, CLAY, silt, and sand with trace gravel.		
5	3			0.0			
6		100					
7	4			0.0		CL	
8							
9	5			0.0			
10		100					
11	6			0.0			
12							
13	7			0.0	10YR5/1 Gray, moist, plastic, CLAY and silt, trace sand.		
14		100					
15	8			0.0			
16							
17	9			0.0			
18		100				CL	
19	10			0.0			
20							
21	11			0.0			
22		100					
23	12			0.0	10YR4/1 Gray, wet, plastic, CLAY, silt, sand.	CL	
24					End of boring at 24.0'.		
25					Notes:		
26					Ground Surface Elevation: 1024.28		
27							
28							
29							
30							

Well: 069MW-008
TOC Elev.: 1023.87



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PARSONS

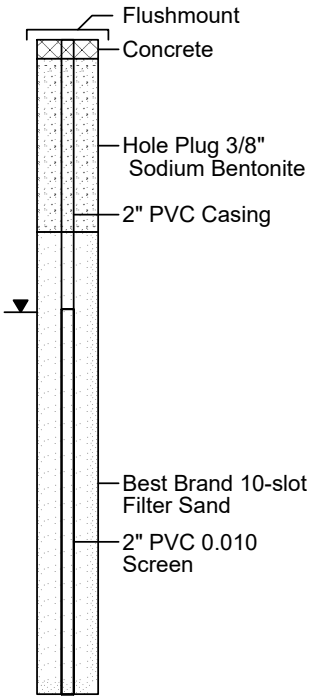
CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
069MW-009

Start Date	: 4 December 2018
End Date	: 5 December 2018
Weather	: 31 F/Cloudy
Northing Coord.	: 551267
Easting Coord.	: 2358007
Total Depth of Boring	: 32.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Auger Inside Diameter	: 4.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1	100		0.0	Grass and Topsoil		
1–2					10YR5/4 Brown, moist, slightly plastic,CLAY, silt, sand, with trace gravel.	CL	
2–3	2			0.0			
3–4	3			0.0			
4–5							
5–6	4	100		0.0			
6–7							
7–8	5			0.0			
8–9							
9–10	6	100		0.0	10YR5/3 Brown, wet, fine SAND and silt, trace gravel.	SP	
10–11							
11–12	7			0.0			
12–13							
13–14	8	100		0.0			
14–15							
15–16	9			0.0			
16–17					7.5YR6/1 Gray, moist, slightly plastic, CLAY and silt.	CL	
17–18	10	100		0.0	7.5YR4/4 Brown, wet, SAND, silt, clay.	SP	
18–19					7.5YR6/1 Gray, moist, slightly plastic, CLAY and silt.	CL	
19–20							
20–21	11			0.0	10YR4/1 Gray, moist, plastic, SILT and clay. Trace sand and gravel.	ML	
21–22		100					
22–23	12			0.0			
23–24							
24–25	13			0.0			
25–26							
26–27	14	100		0.0			
27–28					3" gravely layer	GW	
28–29	15			0.0	10YR5/1 Gray, moist, plastic, SILT and clay. Trace sand and gravel.	ML	
29–30							
30–31	16	100		0.0	GRAVEL and sand. Rounded sandstone fragments.	GP	
31–32							
32–33					End of boring at 32.0'.		
33–34					Notes:		
34–35					Ground Surface Elevation: 1023.71		



PARSONS

CC RVAAP-69
69-1048-SB111

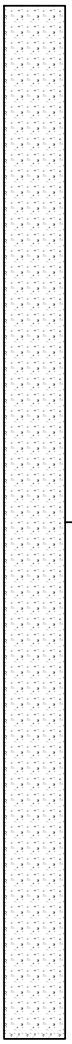
CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551532.30
Easting Coord.	: 2357780.78
Total Depth of Boring	: 23.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB111
Surf. Elev.: 1025.08

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1	100		0.0	10YR4/2 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
2							
3	2			0.0			
4							
5	3			0.2	10YR4/3 Brown, wet, CLAY, silt, sand, trace gravel.	CL	
6		100					
7	4			0.2	10YR4/1 Gray, moist, CLAY, silt, and sand.		
8							
9	5			0.0			
10		100					
11	6			0.0			
12					10YR5/1 Gray, wet, CLAY, silt, and sand.		
13	7		069SB-111-0096-SO	0.0		CL	
14		100					
15	8			0.0			
16							
17	9			0.0			
18		100					
19	10		069SB-111-0097-SO	0.0			
20					Weathered SANDSTONE		
21	11	100		0.0		SS	
22	12		069SB-111-0098-SO				
23					Refusal at 23.0'.		
24							
25							
26							
27							
28							
29							
30							



PARSONS

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

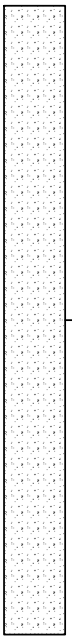
CC RVAAP-69
69-1048-SB112

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551471.53
Easting Coord.	: 2357813.93
Total Depth of Boring	: 14.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB112
Surf. Elev.: 1024.86

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1	75		0.0	10YR5/4 Brown, moist, CLAY, silt, sand, trace gravel.	CL	
2							
3	2			0.0	Wet SAND with some gravel, silt, and clay.	SP	
4							
5	3			0.0	10YR3/2 Brown, moist, CLAY, silt, sand, trace gravel.		
6		100					
7	4			0.0			
8					10YR5/4 Brown, wet, CLAY, silt, sand, trace gravel.	CL	
9	5			0.0			
10		100					
11	6		069SB-112-0099-SO	0.0			
12							
13	7	100		0.0	10YR4/3 Brown, stiff, CLAY, silt, sand, trace gravel.	CL	
14					Refusal at 14.0'.		
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							



PARSONS

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
69-1048-SB113

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551468.49
Easting Coord.	: 2357760.17
Total Depth of Boring	: 24.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB113
Surf. Elev.: 1025.93

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1	75		0.0	Topsoil 10YR3/1 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
1–2							
2–3	2			0.0			
3–4							
4–5	3			0.0			
5–6		100					
6–7	4			0.0			
7–8							
8–9	5			0.0			
9–10							
10–11	6	100	069SB-113-0102-SO	0.0			
11–12					10YR4/2 Brown, wet, SAND, with clay, silt, and gravel.	SP	
12–13	7			0.0	10YR4/2 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
13–14		100					
14–15	8			0.0			
15–16							
16–17	9			0.0	10YR3/1 Gray, moist, CLAY, silt, sand.	CL	
17–18			069SB-113-0103-SO				
18–19	10	100		0.0			
19–20							
20–21	11			0.0			
21–22		100					
22–23	12		069SB-113-0104-SO	0.0			
23–24					10YR4/4 Brown, weathered SANDSTONE	SS	
24–25					End of boring at 24.0'.		
25–30							

Hole Plug 3/8" Sodium Bentonite

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PARSONS

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
69-1048-SB114

Start Date	: 4 December 2018
End Date	: 4 December 2018
Weather	: 31 F/Cloudy
Northing Coord.	: 551478
Easting Coord.	: 2357811
Total Depth of Boring	: 24.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB114
Surf. Elev.: 1024.76

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–5	1			0.0	Moist, 10YR3/3 brown, slightly plastic CLAY, silt, sand, with trace gravel.	CL	
	2			0.0			
	3		069SB-114-0105-SO	0.0			
	4			0.0			
	5			0.0			
5–10			069SB-114-0106-SO		10YR4/4 Brown, wet, CLAY, silt, sand.	CL	
10–15	6			0.0	10YR4/4 Brown, moist, CLAY, silt, sand.	CL	
	7			0.0			
	8		069SB-114-0107-SO	0.0			
15–20	9			0.0	10YR4/1 Gray, moist, plastic, CLAY and silt.	CL	
	10		069SB-114-0108-SO	0.0			
	11			0.0			
20–24	12			0.0	10YR2/2 Brown, wet, SAND with some silt and clay.	SP	
24					End of boring at 24.0'.		

Hole Plug 3/8" Sodium Bentonite

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PARSONS

CC RVAAP-69 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Camp James A. Garfield, Ohio
Portage and Trumbull Counties

CC RVAAP-69
69-1048-SB115

Start Date	: 4 December 2018
End Date	: 4 December 2018
Weather	: 31 F/Cloudy
Northing Coord.	: 551409
Easting Coord.	: 2357872
Total Depth of Boring	: 20.0'

Drilling Company	: Frontz Drilling
Driller	: Bryan Phillips
Designation of Drill	: Geoprobe
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB115
Surf. Elev.: 1024.72

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1	60		0.0	Asphalt - 3" Gravel base.	AR GP	
1–2					10YR5/3 Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.		
2–3	2			0.0			
3–4	3			0.0			
4–5						CL	
5–6	4			0.0			
6–7			069SB-115-0109-SO				
7–8	5			0.0			
8–9							
9–10	6			0.0	10YR3/3 Gray, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
10–11			069SB-115-0110-SO				
11–12	7			0.0	10YR4/2 Brown, wet, SAND and silt, trace clay and gravel.		
12–13							
13–14	8			0.0		SP	
14–15							
15–16	9			0.0	Interbedded, wet, 10YR4/3 brown, SAND between 10YR4/1 gray, moist plastic clay and silt. Sand contains silt and clay.		
16–17							
17–18	10		069SB-115-0111-SO	0.0	4 inches of weathered sandstone at the bottom. Gray clay appears to have varves that are deformed into a "u" shape.		
18–19							
19–20	11			0.0		SP	
20–21							
21–22	12		069SB-115-0112-SO	0.0			
22–23							
23–24	13	50		0.0	Top 6": 10YR4/4 Brown, weathered SANDSTONE Bottom 18": 10YR3/1 Gray CLAY, silt, sand, gravel, and rock fragments. Small organic fragments in very bottom.	SS	
24–25							
25–26	14			0.0			
26–27							
27–28					End of boring at 28.0'.		
28–29							
29–30							

Hole Plug 3/8" Sodium Bentonite

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Photographs of soil cores from SB110

0 – 4 Feet BGS – Brown clay

4 – 8 Feet BGS – Brown clay

8 – 12 Feet BGS – Brown silty sand (8-10 feet); brown grading to gray clay below 10 feet.

12 – 16 Feet BGS – Brown grading to gray clay. Gray clay below 14 or 15 feet bgs.

16 – 20 Feet BGS – Gray clay

20 – 24 Feet – Brown weathered sandstone

Photographs of soil cores from SB110

24 – 28 Feet BGS – Brown weathered sandstone

From:	Ed.Damato@epa.ohio.gov
To:	Shreffler, Rebecca M
Cc:	KATHRYN.S.TAIT.NFG@MAIL.MIL; craig.a.coombs@usace.army.mil; Kevin M Sedlak - ARNG-ILE Clean Up (Kevin.m.sedlak.civ@mail.mil)
Subject:	[EXTERNAL] RE: Correspondence sent 29 August 2019
Date:	Thursday, September 26, 2019 8:43:38 AM

Thank you. Ohio EPA has reviewed the document and has no further comments.

Ed D'Amato
Division of Environmental Response and Revitalization
Ohio EPA
Northeast District Office
2110 E. Aurora Rd
Twinsburg, OH 44087
Direct: (330) 963-1170
Fax: (330) 487-0769
ed.damato@epa.ohio.gov

From: Shreffler, Rebecca M <Rebecca.Shreffler@chenega.com>
Sent: Thursday, August 29, 2019 2:06 PM
To: Damato, Ed <Ed.Damato@epa.ohio.gov>
Cc: Princic, Bob <bob.princic@epa.ohio.gov>; Susan Oliver <soliver@managementsolutionsllc.com>; Tait, Kathryn <KATHRYN.S.TAIT.NFG@MAIL.MIL>; craig.a.coombs@usace.army.mil; Gail Harris <gail.harris@vistasciences.com>; Brillinger, Allan <Allan.Brillinger@chenega.com>; 'Peters, Nathaniel II LRL' <Nathaniel.Peters.II@usace.army.mil>; Tierney, Jennifer M <Jennifer.Tierney@chenega.com>; Schneider, Thomas <Thomas.Schneider@epa.ohio.gov>; Cortney Horne (CHorne@Managementsolutionsllc.com) <CHorne@Managementsolutionsllc.com>; Matt Burghardt <mburghardt@managementsolutionsllc.com>; Kevin M Sedlak - ARNG-ILE Clean Up (Kevin.m.sedlak.civ@mail.mil) <Kevin.m.sedlak.civ@mail.mil>; David Connolly - NG (david.m.connolly8.civ@mail.mil) <david.m.connolly8.civ@mail.mil>; Devlin, Inger D <Inger.Devlin@chenega.com>; Oryshkewych, Natalie <Natalie.Oryshkewych@epa.ohio.gov>; Mcevoy, Liam <Liam.McEvoy@epa.ohio.gov>; 'Mieczkowski, Kevin (USACE)' <Kevin.M.Mieczkowski@usace.army.mil>; Rasik, Carrie <Carrie.Rasik@epa.ohio.gov>; Palombo, Kevin <Kevin.Palombo@epa.ohio.gov>; Heyse, Ed <Ed.Heyse@parsons.com>
Subject: Correspondence sent 29 August 2019

Dear Mr. D'Amato,

Please see attached correspondence sent 29 August 2019 regarding the Response to Comments on the Second Update and Progress Report for Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station.

If you have any questions please contact Mr. David Connolly at 703-607-7589 or david.m.connolly8.civ@mail.mil .

Fed Ex Tracking number : 7761 1218 6682

Happy Trails,

Becky Shreffler

Rebecca Shreffler
Administrative Assistant
Chenega Tri-Services, LLC
Camp James A. Garfield Joint Military Training Center
1438 State Route 534 SW
Newton Falls, OH 44444
P: (330) 872-4411
F: (330) 872-4412
rmshreffler@chenega.com

Did You Know: Children of parents who talk to their teens about drugs are up to 50% less likely to use. Start the conversation: StartTalking.Ohio.Gov

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

August 27, 2019

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Edward D'Amato
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Former Ravenna Army Ammunition Plant (RVAAP) Restoration Program
Remedial Investigation Progress Report for CC RVAAP-69 Building 1048 Fire Station
Portage/Trumbull Counties, Ohio, Contract Number W912QR-12-D-0002, Delivery Order 0003, Ohio EPA ID # 267-000859-214

Dear Mr. D'Amato:

Thank you for your review of the Second Update and Progress Report for Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station in your letter dated 21 August 2019. Please note that the current US Army Corps of Engineers contract with Parsons only includes options for three additional monitoring wells. Your comment regarding the need for additional wells to complete the Remedial Investigation is noted and will be considered during future contract considerations.

Please contact the undersigned at (703) 607-7589 or david.m.connolly8.civ@mail.mil if you have any concerns or questions.

Sincerely,

David M. Connolly
RVAAP Restoration Program Manager
Army National Guard Directorate

cc: Tom Schneider, Ohio EPA, SWDO
Natalie Oryshkewych, Ohio EPA, NEDO, DERR
Bob Princic, Ohio EPA, NEDO, DERR
Liam McEvoy, Ohio EPA, NEDO
Carrie Rasik, Ohio EPA, CO
Kevin Palombo, Ohio EPA, NEDO, DERR
Kevin Sedlak, ARNG, CJAG
Katie Tait, OHARNG, CJAG
Craig Coombs, USACE Louisville
Kevin Mieczkowski, USACE Louisville
Gail Harris, Vista Sciences
Patrick Ryan, Leidos
Ed Heyse, Parsons

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

August 22, 2019

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Mr. Ed D'Amato
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Notification of Field Work, Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Quarterly Sampling for CC RVAAP-69 Building 1048 Fire Station, Ohio EPA ID #s 267-000859-222

Dear Mr. D'Amato:

In accordance with the Director's Final Findings and Orders, Section XIII, #28, for the RVAAP Restoration Program, the Army National Guard (ARNG) is providing notification of field activities at Camp James A. Garfield / former RVAAP 15 days prior to the scheduled start date. Parsons will be conducting quarterly groundwater sampling at CC RVAAP-69 Building 1048 Fire Station during the week of 9 September 2019 (anticipate two days, 10 and 11 September 2019).

For additional information on the field activities, please refer to the *Final Work Plan Additional Sampling for CC RVAAP-69 Building 1048 Fire Station, CC RVAAP-70 East Classification Yard, and CC RVAAP-74 Building 1034-Motor Pool Hydraulic Lift at the former Ravenna Army Ammunition Plant (RVAAP)* submitted to Ohio EPA on 30 November 2017 and approved on 27 December 2017, and the *Final Update and Progress Report on Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station, Ravenna Army Ammunition Plan Restoration Program*, dated 24 July 2018.

Please contact the undersigned at (703) 607-7589 or david.m.connolly8.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,
SEDLAK.KEVIN.MICHAEL.1254440171
Digitally signed by SEDLAK.KEVIN.MICHAEL.1254440171
Date: 2019.08.22 10:23:09 -05'00'
FOR Mr. David M. Connolly
RVAAP Restoration Program Manager
Army National Guard Directorate

cc: Mark Johnson, Ohio EPA, DERR-NEDO
Bob Princic, Ohio EPA, DERR-NEDO
Tom Schneider, Ohio EPA, SWDO
Kevin Sedlak, ARNG, CJAG
Katie Tait, OHARNG, CJAG
Craig Coombs, USACE Louisville
Kevin Mieczkowski, USACE Louisville
Gail Harris, Vista Sciences
Edward Heyse, Parsons

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

August 21, 2019

RE: US Army Ravenna Ammunition
Remediation Response
Correspondence
Remedial Response
Portage County
ID # 267000859214

Mr. David Connolly
Army National Guard Directorate
Environmental Programs Division
ARNG-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Subject: Review of Remedial Investigation Progress Report

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has reviewed the "Second Update and Progress Report for Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station." The document and was received by Ohio EPA on June 12, 2019.

Ohio EPA has the following comments:

1. Ohio EPA concurs with the following:
   - The conclusion that soil impact around the Former Building 1048 Fire Station appears adequately delineated laterally and vertically and that no further soil investigation appears warranted at this time.
   - Sampling results of the existing nine monitoring wells in this area determined that further ground water delineation appears warranted around select wells.
   - The proposed installation of additional monitoring wells 069MW-010 and 069MW-011 to the east and southeast respective 069MW-005, in the unconsolidated aquifer. The additional deeper Upper Sharon Weathered Bedrock monitoring well 069MW-012 is proposed to be adjacent to 069MW-004.

- Pending the sampling and gauging of these proposed well installations, future delineation wells may also be warranted (a well south/southwest of 069MW-007, a well north of 069MW-005, a well east of 069MW-010 and 069MW-011, and an additional deep well downgradient of 069MW-003 and 069MW-012).

2. Ohio EPA recommends the installation of an additional monitoring well north/northeast of 069MW-001 concurrently with the three proposed delineation wells referred to in Comment 1. This additional delineation well location appears warranted based on ground water concentrations of carbon tetrachloride and chloroform, and mounded potentiometric surface contours in that area which could result in potential migration from the former building footprint to the north/northeast.

If you have any questions, please feel free to contact me at (330) 963-1170, or by email at ed.damato@epa.ohio.gov.

Sincerely,

Edward J. D'Amato
Site Coordinator
Division of Environmental Response and Revitalization

ED/sc

ec: David Connolly, ARNG
Kevin Sedlak, ARNG, Camp James A. Garfield
Katie Tait, OHARNG, Camp James A. Garfield
Craig Coombs, USACE Louisville
Nathaniel Peters, USACE Louisville
Rebecca Shreffler, Chenega Tri-Services, LLC
Mark S. Johnson Jr., Ohio EPA, Director's Office
Bob Princic, Ohio EPA, NEDO, DERR
Tom Schneider, Ohio EPA, SWDO, DERR
Liam McEvoy, Ohio EPA, NEDO, DERR
Carrie Rasik, Ohio EPA, CO, DERR
Kevin Palombo, Ohio EPA, CO, DERR

PARSONS

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P: +1 256.837.5200 | F: +1 256.217.2525 | www.parsons.com

Louisville Army Corps of Engineers
Attn: Mr. Kevin Mieczkowski PE, Technical Manager
600 Dr. Martin Luther King Jr. Place
Louisville KY 40202

24 July 2018

Subject: Update and Progress Report on Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station, Ravenna Army Ammunition Plant Restoration Program, Camp Ravenna, Portage and Trumbull Counties, Ohio

Dear Mr. Mieczkowski:

Sampling was conducted in February and March 2018 to address data gaps at CC RVAAP-69 Building 1048 Fire Station as proposed in the *Final Work Plan, Additional Sampling for CC RVAAP-69 Building 1048 Fire Station, CC RVAAP-70 East Classification Yard, and CC RVAAP-74 Building 1034-Motor Pool Hydraulic Lift, Ravenna Army Ammunition Plant Restoration Program, Camp Ravenna, Portage and Trumbull Counties, Ohio*, November 30, 2017. The purpose of this letter is to summarize the results of those sampling events and outline additional sampling to complete the Remedial Investigation. The additional sampling and analyses described in this Update and Progress Report letter are consistent with the objectives of the Work Plan and will follow methodologies described the Work Plan.

Objectives of Additional Sampling

The Final Work Plan (Parsons 2017) contained the following objectives for investigations at CC RVAAP-69:

- Define the vertical extent of carbon tetrachloride in soil near SB101;
- Define the lateral extent of carbon tetrachloride contamination is soil below a depth of 1,018 feet above mean sea level (AMSL); and
- Evaluate impacts to groundwater.

February / March 2018 Investigation Activities

The following activities were conducted to meet those objectives:

- Drilled 4 soil borings and collected soil samples from: SB110 (28 feet below ground surface [bgs]); SB111 (23 feet bgs); SB112 (14 feet bgs) and SB113 (24 feet bgs).

- Collected groundwater grab (screening) samples using direct push drilling techniques at 17 locations (all samples collected near water table).
- Installed and sampled 5 new permanent monitoring wells; four wells (069MW-001, 069MW-002, 069MW-004 and 069MW-005) screened at the water table (screens set from 5-15 or 7-17 feet bgs) and one well (069MW-003) screened in weathered bedrock (23-28 feet bgs).
- Three additional monitoring wells were also installed and sampled at nearby CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift, and these provide information useful to CC RVAAP-69.

Summary of Findings

Historical and 2018 sampling locations are illustrated in Figure 1. Soil sampling results are presented in Table 1. Groundwater grab sample results are presented in Table 2. Groundwater monitoring well results are presented in Table 3.

Soil

Soil sampling results for carbon tetrachloride are illustrated in plan view in Figure 2, in cross section view in Figures 3 and 4, and are summarized below.

- Subsurface geology is primarily brown clays with interbedded silts and sands from the surface to as deep as 15 to 19 feet bgs. (1,006 to 1,010 feet AMSL). A layer of gray clay was encountered below the brown clays. Weathered sandstone was encountered below the gray clay at about 1,005 feet AMSL. Hollow stem auger refusal was encountered at 28 feet bgs (997 feet AMSL) at SB110. Photographs of soil cores from SB110 are attached.
- Carbon tetrachloride and chloroform were detected in soil samples at depths above 14 feet bgs (in the brown clays, sands and silts), which is consistent with previous investigations. Methylene chloride was detected in only one soil sample. Chloromethane was not detected in any soil sample (Table 1).
- The highest concentrations (> 1 mg/kg) of carbon tetrachloride in soil are primarily within the footprint of the former Building 1048 Fire Station (SB101, SB104, SB110, SB112 and RV5-SB2 on Figures 2 and 3).
- SB110 shows no soil impacts in the gray clay or weathered sandstone (below about 1,004 ft AMSL) (Figure 3).
- SB111 and SB113 delineate the lateral extent of contamination in soil to the north and south (Figure 4).
- Refusal for SB112 was encountered at only 14 feet bgs. As a result, it is not clear if soil contamination is delineated to the southeast (SB112 and Figure 3).

Groundwater Presence and Gradients

Groundwater elevations were measured on 5 and 6 March 2018, and observations are summarized below:

- The interpreted water table potentiometric surface indicates a gradient to the southeast (Figure 5). Potentiometric surface elevations and gradient are consistent with facility wide potentiometric surface maps for the unconsolidated aquifer as presented in Facility-Wide Groundwater Annual Reports.
- The water table elevation within the former fire station footprint appeared to be slightly higher than outside of the building footprint in March 2018 as shown by the potentiometric surface in wells 069MW-001 and 069MW-002 (Figure 5).
- Hydraulic head in Well 069MW-001 (screened 5-15 feet bgs) is approximately 1,019.7 feet AMSL, and in Well 06MW-003 (screened 23-28 feet bgs) is approximately 1,016.7 feet bgs, indicating a vertical (downward) gradient from the unconsolidated overburden to the weathered bedrock. The three-foot difference in hydraulic head between these wells suggests that the gray clay layer (located between the two screened intervals) is limiting vertical migration of groundwater.

Groundwater Contamination

Groundwater sampling results are presented in Tables 2 and 3, and illustrated in Figures 6, 7, and 8, and are summarized below.

- Primary contaminants in groundwater are carbon tetrachloride and chloroform. Lower concentrations of methylene chloride were also detected and are generally coincident with higher concentrations of chloroform. Chloromethane was not detected in any sample.
- Groundwater grab sample results (Table 2 and Figure 6):
  - Carbon tetrachloride was delineated to maximum contaminant level (MCL) (5 µg/L) in every direction except north of 069WP-001;
  - The highest concentrations of carbon tetrachloride (> 100 µg/L) detected at 069WP-001, 069WP-004 and 069WP-003 were within the former Building 1048 Fire Station footprint;
  - Lower concentrations of carbon tetrachloride detected (< 5 µg/L) to east (069WP-006) and southeast (069WP-016) suggested migration in these directions; and
  - Concentrations of all contaminants were below detection limits in sample 069WP-015 near Range Control Building.
- Monitoring wells sample results (Table 3 and Figures 7 and 8 – note, carbon tetrachloride concentration contours were estimated using both grab sample and monitoring well results):
  - Carbon tetrachloride and chloroform were detected in all four newly installed water table wells. Carbon tetrachloride concentrations were > 100 µg/L in wells 069MW-001 and 069MW-004;
    - Carbon tetrachloride concentrations exceeded the MCL of 5 µg/L in wells 069MW-001 and 069MW-004.
    - Chloroform concentration exceeded the MCL of 80 µg/L in well 069MW-001.
    - Methylene chloride concentration exceeded the MCL of 5 µg/L in well 069MW-003.

- Carbon tetrachloride DNAPL is unlikely to be present because dissolved concentrations in groundwater are much lower that the solubility limit of 800,000 µg/L;
- The VOC plume extent is not defined to the southeast of well 069MW-004 (Figure 7). However, carbon tetrachloride was not detected in CC RVAAP-74 wells (Figure 8) located about 500 feet southeast, indicating that the plume does not migrate as far as CC RVAAP-74;
- VOC concentrations in 069MW-002 (upgradient) and 069MW-005 (to the east) are below MCL but above FWCUG; and
- The sample from deep well 069MW-003 contained chloroform and methylene chloride but not carbon tetrachloride. It is unclear if these contaminants were introduced during drilling the well, or if they indicate vertical migration and reductive dechlorination of dissolved contaminants.

Potential Vapor Intrusion

- The only currently occupied building near the site is Range Control (located east of CC RVAAP-69).
- Carbon tetrachloride (4.8 µg/L) and chloroform (0.56B µg/L) were detected in groundwater at 069MW-005 (140 feet west of the Range Control Building). Neither compound was detected the groundwater grab sample at 069WP-015 located 50 feet west of the building.
- The USEPA Vapor Intrusion Screening Level (VISL) calculator indicates that carbon tetrachloride concentrations below 27.7 µg/L and chloroform concentrations below 53.3 µg/L in groundwater will not pose a cancer risk above 10^{-5}.
- Current data suggests no unacceptable risk from vapor intrusion to occupants of the Range Control Building.

Actions to Complete the Remedial Investigation:

The following actions are designed to complete the Remedial Investigation CC RVAAP-69 Building 1048 Fire Station.

- Complete vertical and lateral delineation of carbon tetrachloride and chloroform in soil (Figure 9).
  - Advance two soil borings to the top of the weathered bedrock (approximately 20 feet bgs). Collect soil samples every 5 feet for chlorinated methane analysis (note: use same approach as described for SB110 – SB113 in the Work Plan). Bias samples toward vertical intervals with elevated PID reading as well as silt or sand layers (potential migration pathways). Collect at least one sample from the gray clay layer.
    - SB114 will be located within the former Building 1048 footprint (between SB101 and SB112); and
    - SB115 will be located southeast of the former Building 1048 near 069MW-004.
- Delineate carbon tetrachloride and chloroform in shallow groundwater by installing and sampling shallow monitoring wells (Figure 10).

- 069MW-006 will be located northwest of 069MW-002 to provide a sample location upgradient of plume;
- 069MW-007 will be located south of the centerline of the plume to confirm grab sample results and delineate the plume to the southwest;
- 069MW-008 and 069MW-009 will be located southeast of 069MW-004 (west and east of George Road, respectively) to define downgradient plume. Note that these locations may need to be adjusted to avoid utilities along George Road;
- If concentrations of carbon tetrachloride or chloroform increase in well 069MW-005, a new well may be needed closer to the Range Control Building to screen for the potential for vapor intrusion; and
- Additional wells may be needed to define downgradient extent of the plume in shallow groundwater.

- Investigate potential vertical migration of carbon tetrachloride reductive dechlorination intermediate products (e.g., chloroform) in groundwater.
  - Continue to monitor deep monitoring well 069MW-003. If chlorinated methanes are detected at concentrations above FWCUGs in 069MW-003 during the June 2018 sampling event, redevelop well prior to the September sampling event. If chlorinated methanes continue to be detected above FWCUGs in 069MW-003, install additional deep monitoring wells at CC RVAAP-69.

Please contact me at 256.217.2573 or email ed.heyse@parsons.com if you have any questions.

Sincerely

Edward Heyse, PhD, PE
Project Manager

CC: Ed D'Amato, Ohio EPA DERR (3 electronic copies, 1 hard copy)
Tom Schneider, Ohio EPA, SWDO (1 electronic copy)
Mark Johnson, Ohio EPA, DERR-NEDO (transmittal letter only)
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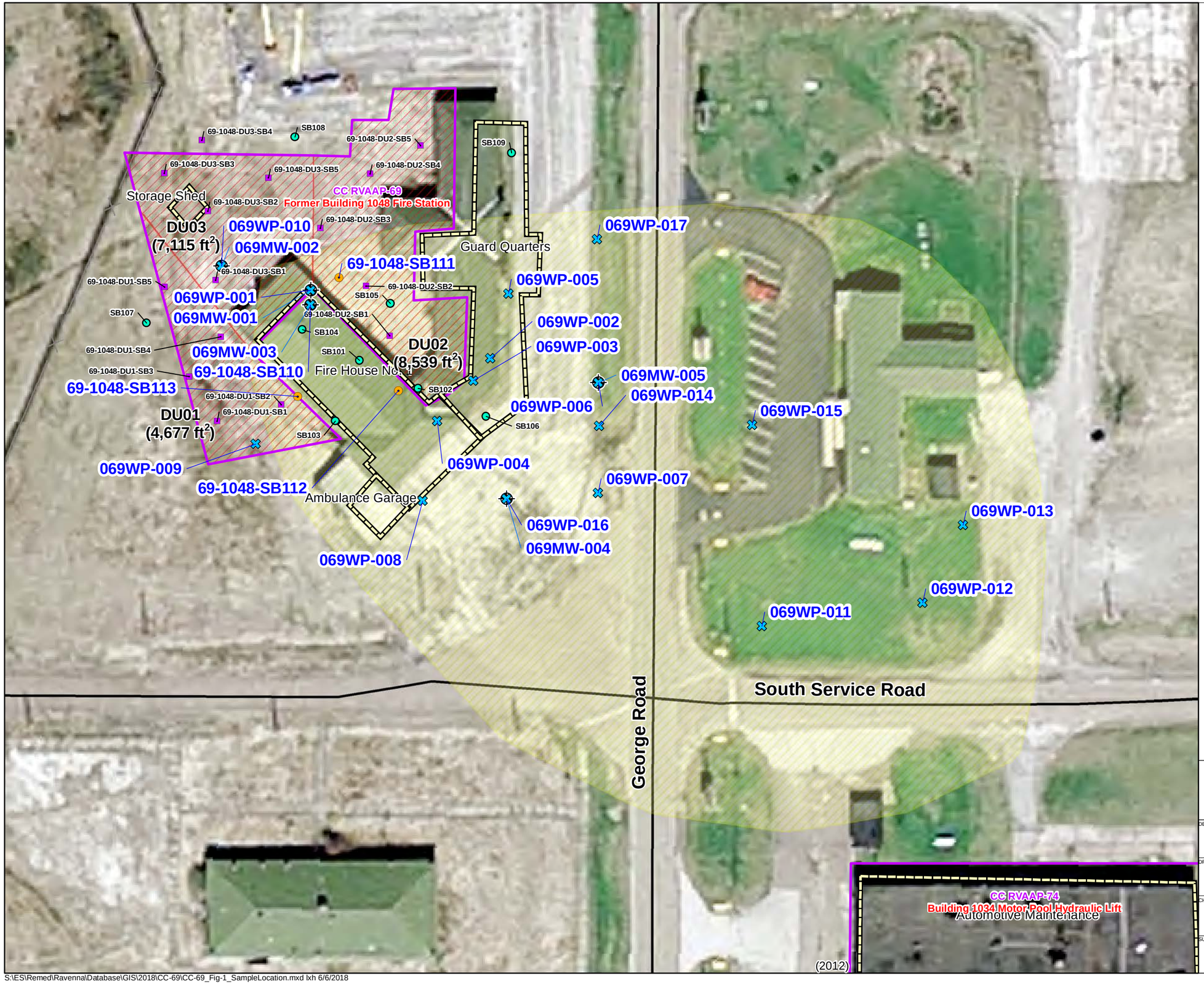
Craig Coombs, USACE Louisville (transmittal letter only)
Kevin Sedlak, ARNG (1 electronic copy)
Katie Tait, OHARNG (1 electronic copy)
Gail Harris, Vista Sciences (2 hard copies, 2 electronic copies)
Pat Ryan, Leidos (transmittal letter only)
Lauri Roche, Parsons

Attached

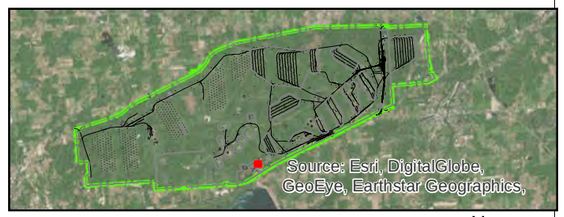
10 Figures
3 Tables
Boring Logs and Well Completion Diagrams
Photographs



Legend

- Installation Boundary
- Former UST RV-5 (100-gallon gasoline tank)
- 2012 Direct Push Boring Location
- 2015 Field Change Notice Subsurface Soil Boring
- 2018 Soil Sample Direct-Push Boring Location
- 2018 Groundwater Well Point Location (Grab Sample)
- 2018 Groundwater Monitoring Well
- Area of Concern
- 2012 Decision Unit
- Fence Line
- Elevation contour (ft)
- Former Structures
- Step-in or Step-out Groundwater Grab Samples Locations To Be Determined

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. DU = Decision Unit
3. ID = Identification
4. RVAAP = Ravenna Army Ammunition Plant
5. CC = Army Environmental Compliance-Related Cleanup Program
6. ISM = Incremental Sampling Methodology
7. Initial groundwater grab sample locations are indicated on the figure. Subsequent step-in or step-out groundwater grab locations will be located in the indicated shaded area based on earlier grab sample results.



N

0 50 100 Feet

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT	Figure 1 Sampling Locations CC RVAAP-69 Building 1048 Fire Station
DRAWN BY: LH	
CHECKED BY: EH	SCALE: As Shown; PROJECT NUMBER: 640030.0005.110051
SUBMITTED BY: EH	DATE: 6/6/2018; FILE: ; FIGURE NUMBER: 1

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69-1048-DU3-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-DU3-SB4
11/12/2012 : **0.0087** CT [1 - 7]

69-1048-DU3-SB
11/12/2012 : **0.002J** CT [1 - 4]
11/12/2012 : **0.0027J** CT [4 - 7]

69-1048-DU2-SB3
11/12/2012 : ND CT [1 - 7]

69-1048-DU3-SB3
11/12/2012 : **0.00072J** CT [1 - 7]

69-1048-DU3-SB2
11/12/2012 : **0.0014J** CT [1 - 7]

69-1048-SB111
02/06/2018 : **0.5** CT [13 - 14]
02/06/2018 : ND CT [19 - 20]
02/06/2018 : ND CT [22 - 23]

69-1048-DU3-SB1
11/12/2012 : **0.003J** CT [1 - 7]
11/12/2012 : **0.0027J** CT [7 - 13]

69-1048-DU1-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-SB107
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

69-1048-SB110
02/06/2018 : **4.9** CT [11 - 12]
02/06/2018 : **7J** CT [11 - 12]
02/06/2018 : ND CT [19 - 20]
02/06/2018 : ND CT [22 - 23]
02/06/2018 : ND CT [27 - 28]

69-1048-DU1-SB4
11/12/2012 : **0.015** CT [1 - 7]

69-1048-DU1-SB3
11/12/2012 : ND CT [1 - 7]

69-1048-SB104
04/07/2015 : **0.31J** CT [2 - 3]
04/07/2015 : **1.4** CT [4 - 5]
04/07/2015 : **8.2J** CT [5 - 6]
04/07/2015 : **13J** CT [7 - 8]
04/07/2015 : **12J** CT [9 - 10]
04/29/2015 : **4.9J** CT [12 - 13]
04/29/2015 : **0.00086J** CT [14 - 15]

69-1048-DU1-SB
11/12/2012 : ND CT [1 - 4]
11/12/2012 : ND CT [4 - 7]

69-1048-DU1-SB1
11/12/2012 : ND CT [1 - 7]

69-1048-DU1-SB2
11/12/2012 : ND CT [1 - 7]

69-1048-SB113
02/06/2018 : ND CT [10 - 11]
02/06/2018 : ND CT [17 - 18]
02/06/2018 : ND CT [22 - 23]

69-1048-SB108
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]

69-1048-DU2-SB4
11/12/2012 : ND CT [1 - 7]

69-1048-DU2-SB5
11/12/2012 : ND CT [1 - 7]

69-1048-DU2-SB
11/12/2012 : ND CT [1 - 4]
11/12/2012 : **0.0027J** CT [4 - 7]

69-1048-SB109
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

69-1048-DU2-SB2
11/12/2012 : **0.17** CT [1 - 7]

69-1048-SB105
04/07/2015 : ND CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : **0.0014J** CT [7 - 8]
04/07/2015 : **0.087** CT [7 - 10]
04/07/2015 : **0.7J** CT [9 - 10]

069MW-005

69-1048-DU2-SB1
11/12/2012 : **0.0012J** CT [1 - 7]

69-1048-SB106
04/29/2015 : ND CT [5 - 6]
04/29/2015 : ND CT [7 - 8]
04/29/2015 : ND CT [9 - 10]
04/29/2015 : ND CT [12 - 13]

069MW-004

69-1048-SB102
04/07/2015 : **0.00063J** CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : ND CT [7 - 8]
04/07/2015 : **0.52** CT [7 - 10]
04/07/2015 : **0.55J** CT [9 - 10]

69-1048-SB112
02/06/2018 : **7.7J** CT [11 - 12]
02/06/2018 : **9.6** CT [11 - 12]

69-1048-SB103
04/07/2015 : ND CT [2 - 3]
04/07/2015 : ND CT [4 - 5]
04/07/2015 : ND CT [5 - 6]
04/07/2015 : ND CT [7 - 8]
04/07/2015 : ND CT [7 - 10]
04/07/2015 : ND CT [9 - 10]

69-1048-SB101
04/07/2015 : **0.37J** CT [2 - 3]
04/07/2015 : **0.52** CT [4 - 5]
04/07/2015 : **4.7** CT [5 - 6]
04/07/2015 : **8.4J** CT [7 - 8]
04/07/2015 : **7.9J** CT [9 - 10]
04/07/2015 : **5.4J** CT [9 - 13]
04/07/2015 : **3.8J** CT [12 - 13]
04/29/2015 : **2.5** CT [13 - 14]
04/29/2015 : **4.6** CT [14 - 15]
04/29/2015 : **3.2J** CT [15 - 16]

72-1048-RV5-SB2
12/03/2012 : **14J** CT [5 - 6]

CC RVAAP-69
Former Building 1048 Fire Station

DU03
(7,115 ft^2)

DU02
(8,539 ft^2)

DU01
(4,677 ft^2)

069MW-002
069MW-001
069MW-003
RV-5

Guard Quarters
Fire House No. 1
Ambulance Garage

A
A'
C
C'

George Road
South Service Road

(2012)

Location ID — 69-1048-DU1-SB2
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)

Legend

- Installation Boundary
- 2018 Groundwater Monitoring Well Location
- Former UST RV-5 (100-gallon gasoline tank)
- 2012 CC RVAAP-72 SI Direct Push Boring Not Analyzed for VOCs
- 2012 Direct Push Boring Location
- 2015 Field Change Notice Subsurface Soil Boring
- 2018 Subsurface Soil Boring
- Decision Unit
- Cross-Section Trace
- Elevation contour (ft)
- Fence Line
- Former Structures
- 0.7 J — Concentration Exceeds Most Stringent EPA RSL for Resident Soil (TR=1E-06/THQ=0.1) of 0.65 mg/kg
- ISM Horizontal Sample for Decision Unit

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride at each previous sampling location. There is not a FWCUG for carbon tetrachloride in soil; therefore, carbon tetrachloride concentrations in soil were compared to the lower of the November 2017 EPA RSL for Resident Soil at the 10^{-6} target cancer risk level and non-carcinogenic target hazard quotient using the 0.1 risk. Concentrations which exceed the most stringent RSL are in **RED**
   EPA Residential RSL for carbon tetrachloride is 0.65 mg/kg.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. ISM = Incremental Sampling Methodology

N

0 40 Feet

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

Figure 2

Soil Sample Results
CC RVAAP-69 Building 1048 Fire Station
Carbon Tetrachloride Detections

DESIGNED BY: BT			
DRAWN BY: LH			
CHECKED BY: EH	SCALE: As Shown	PROJECT NUMBER: 640030.0005.110051	
SUBMITTED BY: EH	DATE: 6/4/2018	FIGURE NUMBER:	2
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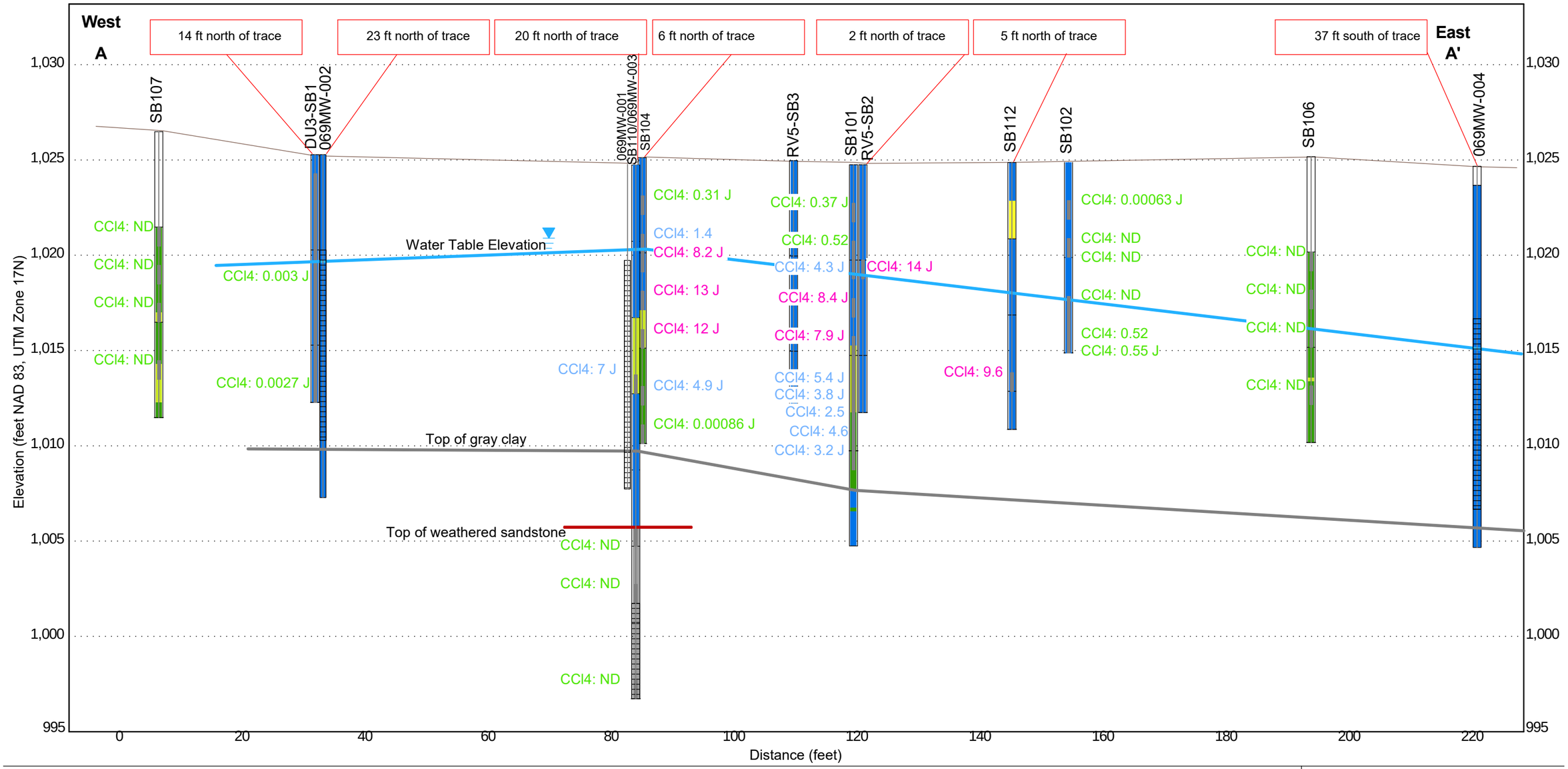


LEGEND

- GROUND SURFACE ELEVATION (feet NAD 83, UTM Zone 17N)
- SB101 — SAMPLE LOCATION
- SAMPLE INTERVAL (feet)
- Water Table Elevation (feet)
- SCREEN INTERVAL (feet)

SOIL LITHOLOGY AND HYDRAULIC CONDUCTIVITY RANGES

RELATIVE PERMEABILITY

- SP: 2.55 x 10^{-3} to 5.35 x 10^{-2} cm/sec
- SM: 1 x 10^{-6} to 5 x 10^{-4} cm/sec
- SC: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- ML: 5 x 10^{-7} to 1 x 10^{-4} cm/sec
- CL: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- CH: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- SS: 3 x 10^{-8} to 6 x 10^{-4} cm/sec
- NO SAMPLE RECOVERY

NOTES:
Purple Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 100X analyte screening level).
Scarlet Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 10X analyte screening level).
Blue Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (1 to 10X analyte screening level).
Green Label = Sample Does Not Exceed Cleanup Goal (0.65 mg/kg).
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
CCl4= Carbon Tetrachloride
ND = Not detected.
NA=Not available.
NAD 83 = UTM Zone 17N.
DU=Decision Unit
RVAAP= Ravenna Army Ammunition Plant
ft=feet
SB=Soil Boring
*72-1048-RV5-SB2 was collected in the location of 69-1048-SB101
**69-1048-DU3-SB1 was collected using Incremental Sampling Methodology.

FIGURE 3

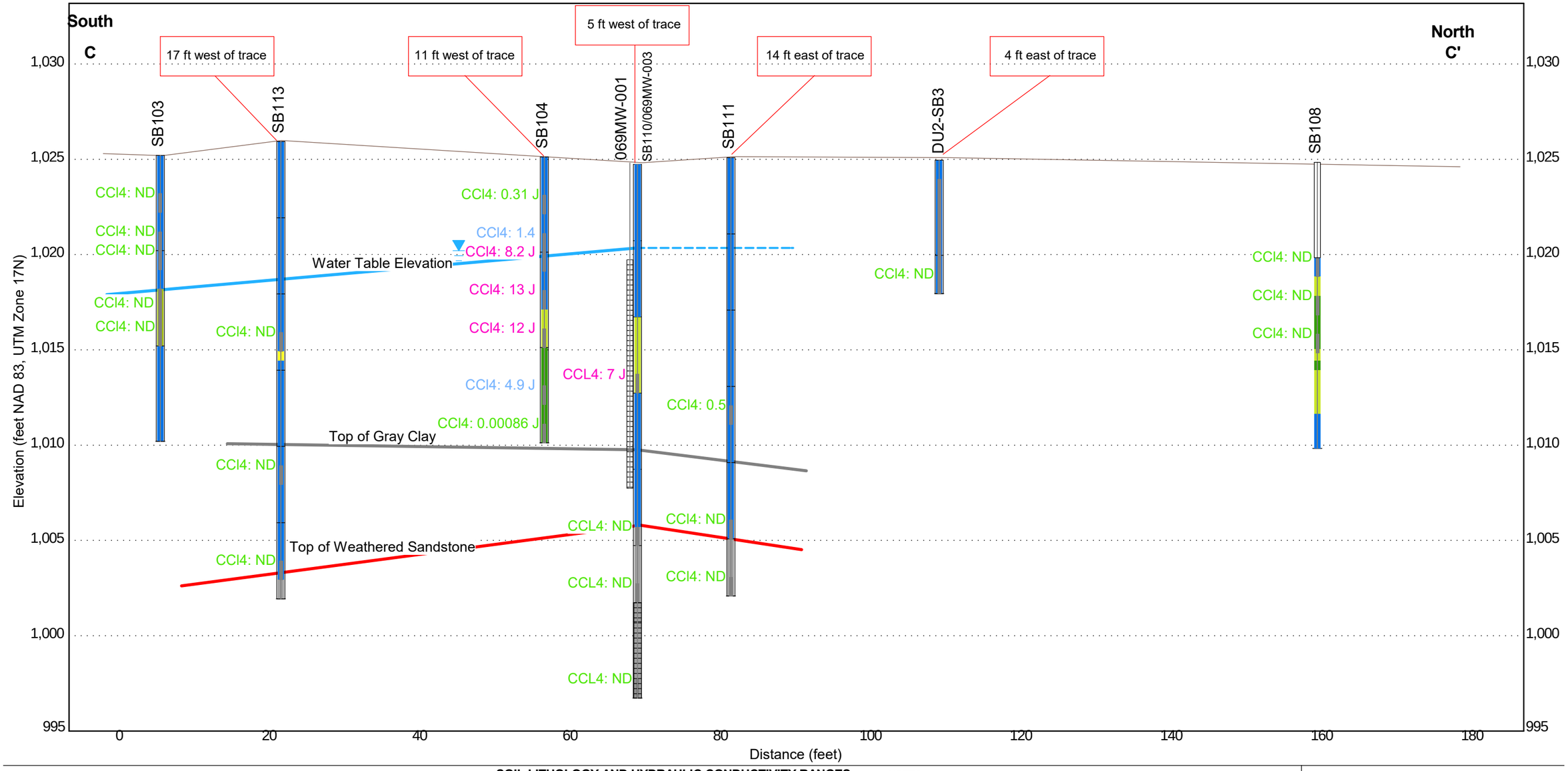
CC RVAAP-69 Building 1048 Fire Station

Cross Section A-A'

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

P A R S O N S

\\CODEN10FS01\PRJDATA\ES\REMED\748917 GALENA FOL\03000 FIELD WORK\GINT LIBRARY (LOGS)\OFFICIAL GINT FILES\GALENA FENCE\MASTER DATABASE\GINT_GALENA_AMENDED_ALL (2).GPJ;



LEGEND

- GROUND SURFACE ELEVATION (feet NAD 83, UTM Zone 17N)
- SB108 — SAMPLE LOCATION
- SAMPLE INTERVAL (feet)
- WATER TABLE ELEVATION (feet)
- SCREEN INTERVAL (feet)

SOIL LITHOLOGY AND HYDRAULIC CONDUCTIVITY RANGES

RELATIVE PERMEABILITY

- SP: 2.55 x 10^{-3} to 5.35 x 10^{-2} cm/sec
- SM: 1 x 10^{-6} to 5 x 10^{-4} cm/sec
- SC: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- ML: 5.5 x 10^{-7} to 5.5 x 10^{-4} cm/sec
- CL: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- CH: 5 x 10^{-8} to 5 x 10^{-6} cm/sec
- SS: 3 x 10^{-8} to 6 x 10^{-4} cm/sec
- NO SAMPLE RECOVERY

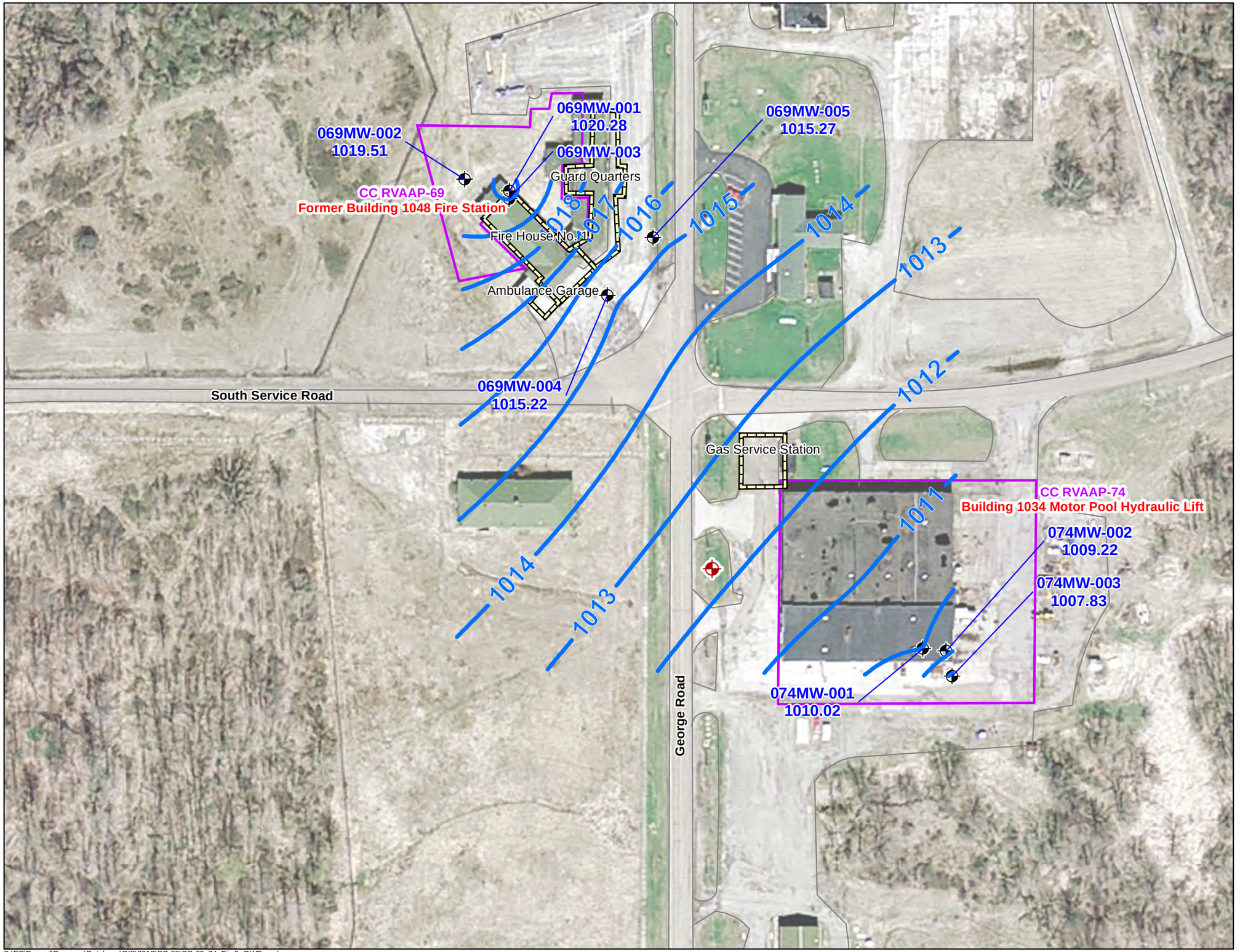
NOTES:
Purple Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 100X analyte screening level).
Scarlet Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (Greater than 10X analyte screening level).
Blue Label = SRC Concentration Exceeds Most Stringent Cleanup Goal (1 to 10X analyte screening level).
Green Label = Sample Does Not Exceed Cleanup Goal (0.65 mg/kg).
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
CCl4= Carbon Tetrachloride
ND = Not detected.
NA=Not available.
NAD 83 = UTM Zone 17N.
DU=Decision Unit
RVAAP= Ravenna Army Ammunition Plant
ft=feet
SB=Soil Boring

FIGURE 4

CC RVAAP-69 Building 1048 Fire Station

Cross Section C-C'

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio



LEGEND

- Potentiometric Surface at March 5 - 6, 2018
- Groundwater Monitoring Well
- Inactive Groundwater Supply Well
- Former Structure
- Area of Concern
- Road

NOTES & SOURCES

1. Map Coordinates: NAD 83, UTM Zone 17N, 2006 Orthoimagery from Ohio Statewide Imagery Program (OSIP)
2. Contour Elevations in Feet.
3. RVAAP = Ravenna Army Ammunition Plant
4. CC = Army Environmental Compliance-Related Cleanup Program

0 100 Feet

N

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

Figure 5
Potentiometric Surface
CC RVAAP-69 Building 1048 Fire Station
CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift

SCALE:	As Shown	PROJECT NUMBER:	640030.0002.110051
DATE:	6/5/2018	FIGURE NUMBER:	5
FILE:			

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CC RVAAP-69
Former Building 1048 Fire Station

069WP-010
02/07/2018 : 0.18 U CT [2 - 12]
02/07/2018 : 0.10 U CF [2 - 12]

069WP-001
02/01/2018 : **1000** CT [7 - 12]
02/01/2018 : **110** CF [7 - 12]

RV-5

069WP-003
02/01/2018 : **230** CT [6 - 16]
02/01/2018 : **150** CF [6 - 16]

069WP-004
02/01/2018 : **320** CT [10 - 20]
02/01/2018 : **190** CF [10 - 20]

069WP-009
02/07/2018 : 1.8 U CT [6 - 16]
02/07/2018 : 1.0 U CF [6 - 16]

069WP-008
02/12/2018 : 0.18 U CT [10 - 20]
02/12/2018 : 0.10 U CF [10 - 20]

069WP-016
02/14/2018 : **1** CT [6 - 16]
02/14/2018 : **0.41J** CF [6 - 16]

069WP-017
02/15/2018 : 0.18 U CT [5 - 20]
02/15/2018 : 0.10 U CF [5 - 20]

069WP-005
02/07/2018 : 3.6 U CT [10 - 20]
02/07/2018 : 2.0 U CF [10 - 20]

069WP-002
02/01/2018 : **7.3** CT [6 - 16]
02/01/2018 : **1.2** CF [6 - 16]

069WP-006
02/07/2018 : **3.2J** CT [6 - 16]
02/07/2018 : **0.7J** CF [6 - 16]

069WP-015
02/12/2018 : 0.18 U CT [10 - 20]
02/12/2018 : 0.10 U CF [10 - 20]

069WP-014
02/12/2018 : 0.18 U CT [6 - 16]
02/12/2018 : 0.10 U CF [6 - 16]

069WP-007
02/12/2018 : 0.18 U CT [6 - 16]
02/12/2018 : 0.10 U CF [6 - 16]

RV-23

069WP-013
02/08/2018 : 0.18 U CT [1 - 16]
02/08/2018 : 0.10 U CF [1 - 16]

069WP-011
02/08/2018 : 0.18 U CT [4 - 24]
02/08/2018 : 0.10 U CF [4 - 24]

069WP-012
02/09/2018 : 0.91 U CT [6 - 16]
02/09/2018 : 0.50 U CF [6 - 16]

5
5
100

George Road
South Service Road

CC-RVAAP-72-07 RV-2
CC-RVAAP-72-07
(2012)

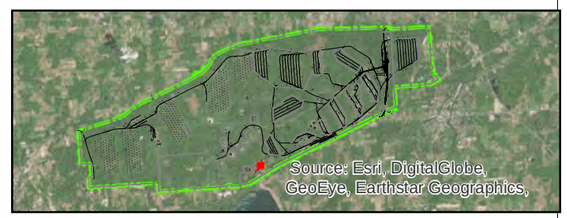
Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Location ID — **069WP-008**
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)

Legend

- Installation Boundary
- 2018 Groundwater Well Point Location (Grab Sample)
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater grab samples at each well point sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=$10^{-6}$and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal



N

0 40 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT	Figure 6		
DRAWN BY: LH	Groundwater Grab Samples CC RVAAP-69 Building 1048 Fire Station		
CHECKED BY: EH	SCALE: As Shown	PROJECT NUMBER: 640030.0005.110051	
SUBMITTED BY: EH	DATE: June 2018	FIGURE NUMBER:	6
	FILE:		

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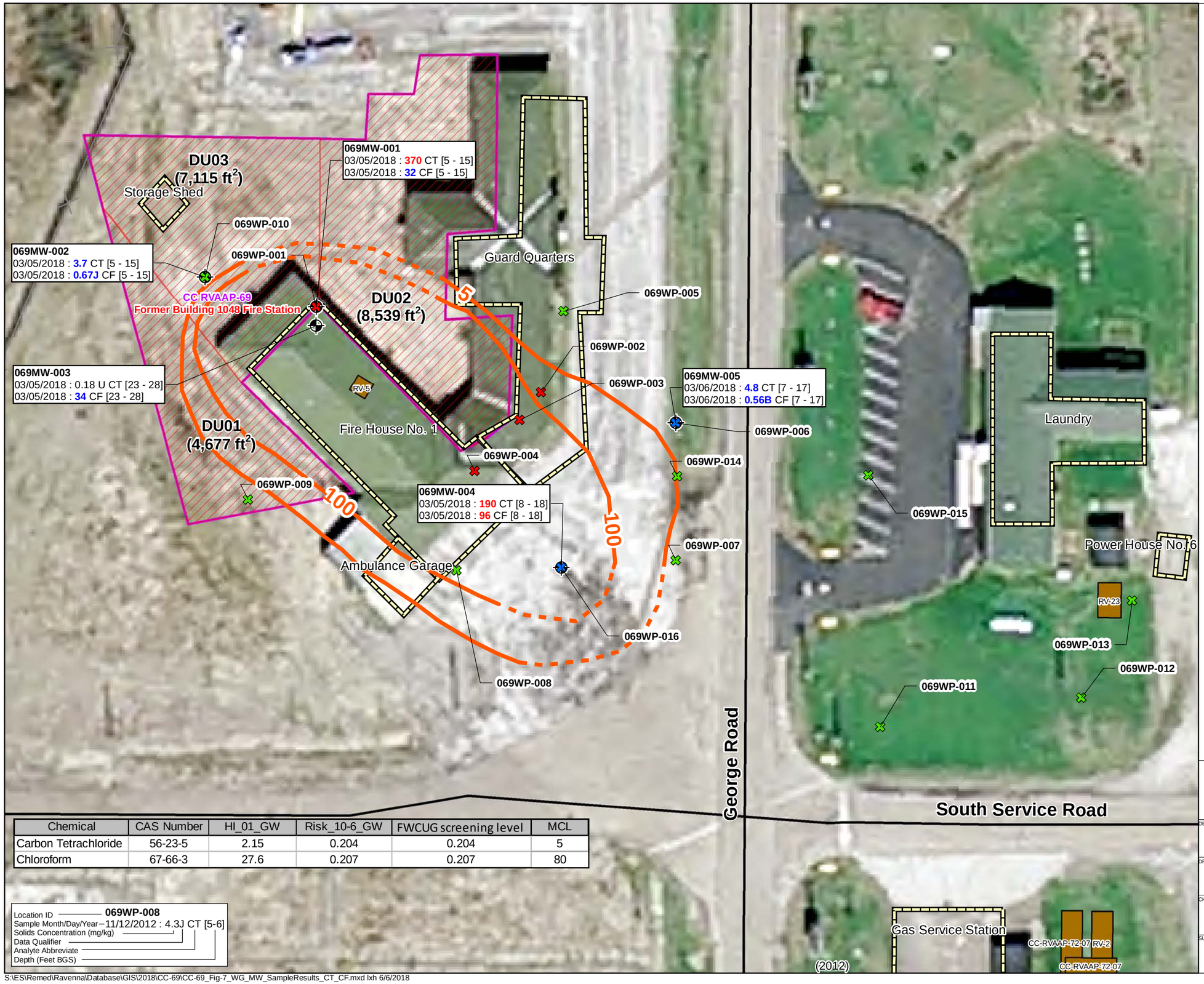


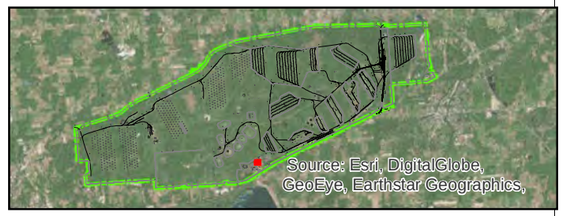
Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Location ID — **069WP-008**
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)

Legend

- Installation Boundary
- 2018 Groundwater Well Point Location (Grab Sample) where concentration > MCL
- 2018 Groundwater Well Point Location (Grab Sample) where concentration > FWCUG
- 2018 Groundwater Well Point Location (Grab Sample) where concentration < FWCUG
- 2018 Groundwater Monitoring Well Location
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater grab samples at each well point sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=$10^{-6}$and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal



N

0 40 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT
DRAWN BY: LH
CHECKED BY: EH
SUBMITTED BY: EH

Figure 7

Groundwater Monitoring Wells
CC RVAAP-69 Building 1048 Fire Station

SCALE: As Shown
DATE: June 2018
FILE:
PROJECT NUMBER: 640030.0005.110051
FIGURE NUMBER: 7

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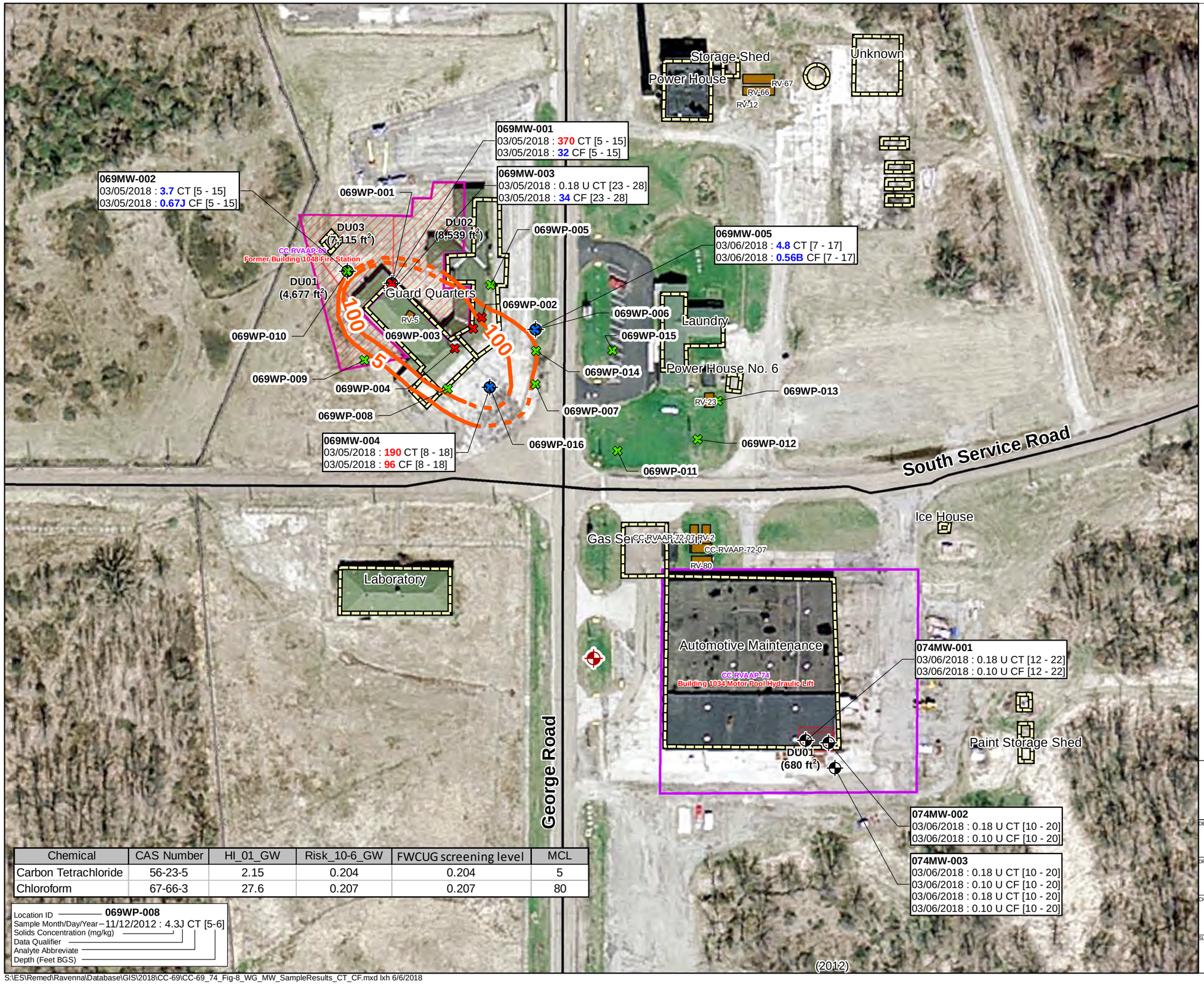


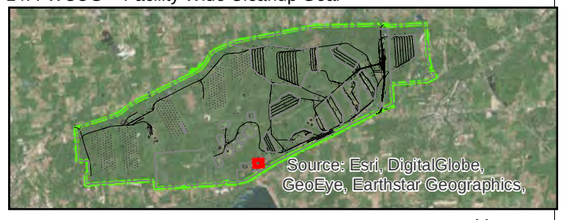
Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Location ID — **069WP-008**
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)

Legend

- Installation Boundary
- 2018 Groundwater Well Point Location (Grab Sample) where concentration > MCL
- 2018 Groundwater Well Point Location (Grab Sample) where concentration > FWCUG
- 2018 Groundwater Well Point Location (Grab Sample) where concentration < FWCUG
- 2018 Groundwater Monitoring Well Location
- Inactive Groundwater Supply Well
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater grab samples at each well point sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=$10^{-6}$and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal



0 100 Feet

N

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

Figure 8

Groundwater Monitoring Wells
CC RVAAP-69 Building 1048 Fire Station
CC RVAAP-74 Building 1034
Motor Pool Hydraulic Lift

DESIGNED BY: BT	SCALE: As Shown	PROJECT NUMBER: 640030.0005.110051	
DRAWN BY: LH	DATE: June 2018	FIGURE NUMBER:	8
CHECKED BY: EH			
SUBMITTED BY: EH	FILE:		

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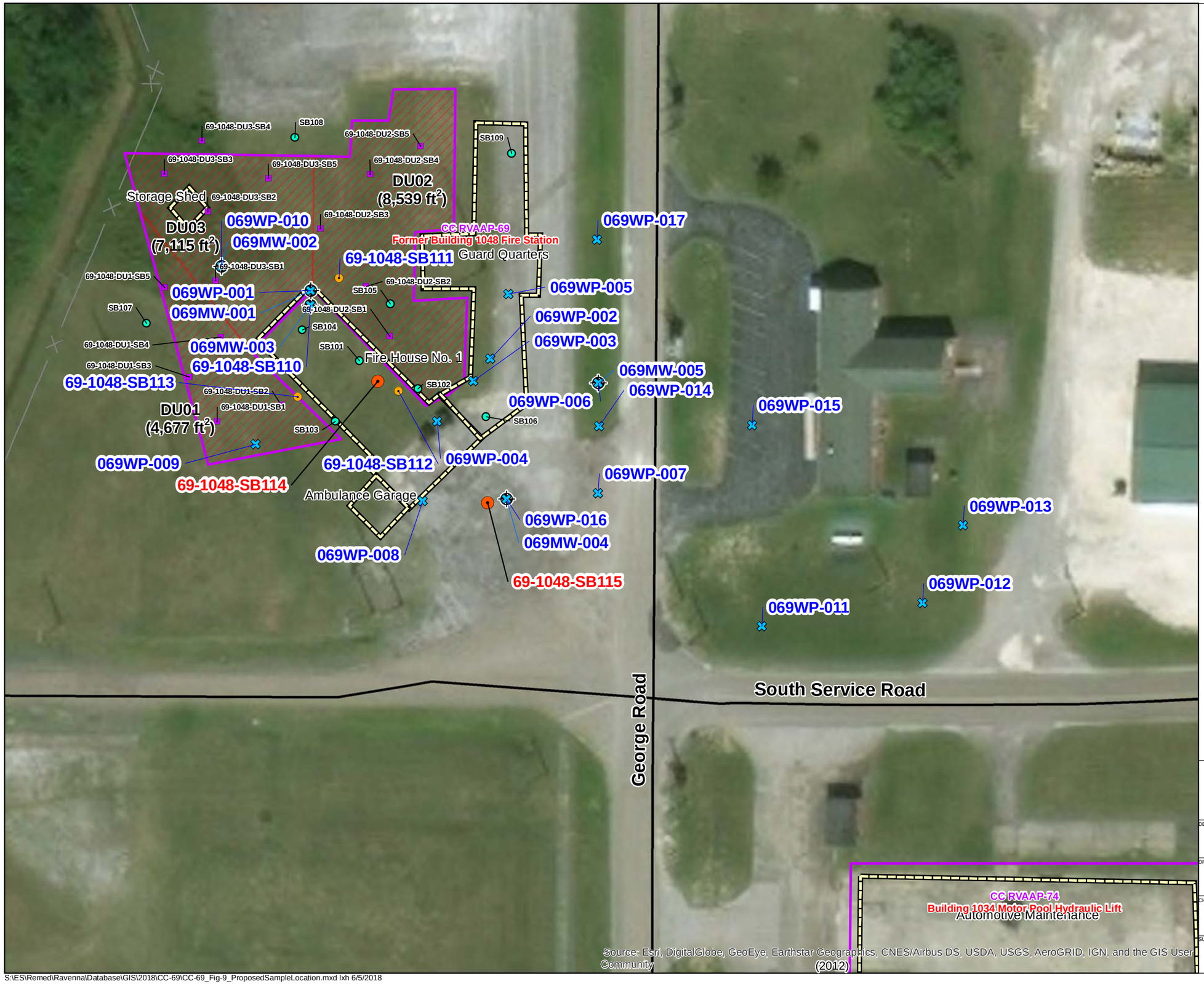
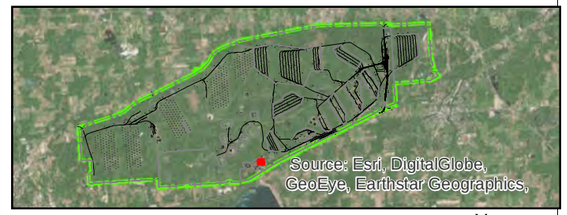


Legend

- Installation Boundary
- Former UST RV-5 (100-gallon gasoline tank)
- Proposed Soil Borings into Weathered Bedrock
- 2012 Direct Push Boring Location
- 2015 Field Change Notice Subsurface Soil Boring
- 2018 Soil Sample Direct-Push Boring Location
- 2018 Groundwater Well Point Location (Grab Sample)
- 2018 Groundwater Monitoring Well
- Area of Concern
- 2012 Decision Unit
- Fence Line
- Elevation contour (ft)
- Former Structures
- Step-in or Step-out Groundwater Grab Samples Locations To Be Determined

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. DU = Decision Unit
3. ID = Identification
4. RVAAP = Ravenna Army Ammunition Plant
5. CC = Army Environmental Compliance-Related Cleanup Program
6. ISM = Incremental Sampling Methodology
7. Initial groundwater grab sample locations are indicated on the figure. Subsequent step-in or step-out groundwater grab locations will be located in the indicated shaded area based on earlier grab sample results.



N

0 50 100 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

DESIGNED BY: BT	Figure 9
DRAWN BY: LH	Proposed Soil Sample Locations
CHECKED BY: EH	CC RVAAP-69 Building 1048 Fire Station
SUBMITTED BY: EH	SCALE: As Shown; PROJECT NUMBER: 640030.0005.110051
	DATE: 6/5/2018; FIGURE NUMBER: 9
	FILE:

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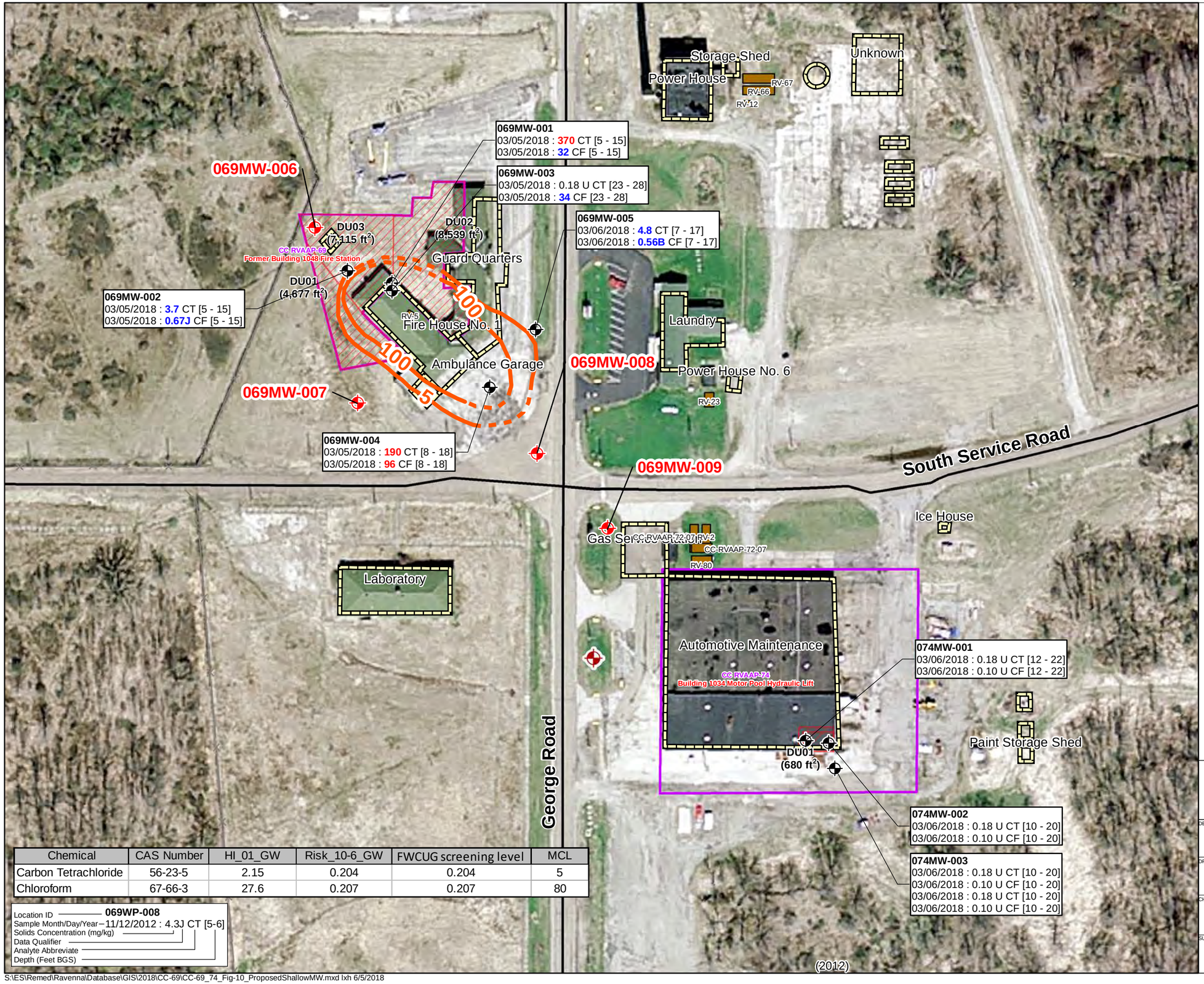


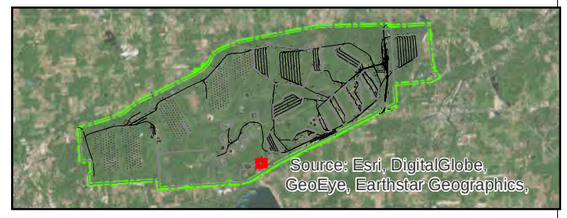
Legend

- Installation Boundary
- Inactive Groundwater Supply Well
- Proposed Shallow Groundwater Monitoring Well
- 2018 Groundwater Monitoring Well Location
- Carbon tetrachloride concentration contour (dashed where inferred)
- Decision Unit
- Elevation contour (ft)
- Fence Line
- Cross-Section Trace
- Former Structures

1. Map Coordinates: NAD 83, UTM Zone 17N, 2009 Orthoimagery from USGS.
2. Concentrations shown are for carbon tetrachloride and chloroform in groundwater grab samples at each well point sampling location. Concentrations are shown in **BLUE** if concentration exceeds lowest FWCUG screening level for cancer risk=$10^{-6}$and non-carcinogenic hazard quotient =0.1, and **RED** if concentration exceeds the MCL.
3. CT = Carbon Tetrachloride
4. J = estimated
5. ND = not detected
6. All concentration are in milligrams per kilogram (mg/kg)
7. DU = Decision Unit
8. ID = Identification
9. RVAAP = Ravenna Army Ammunition Plant
10. CC = Army Environmental Compliance-Related Cleanup Program
11. **Bold** = detect
12. CF = Chloroform
13. MCL = Safe Drinking Water Act Maximum Contaminant Level
14. FWCUG = Facility Wide Cleanup Goal

Chemical	CAS Number	HI_01_GW	Risk_10-6_GW	FWCUG screening level	MCL
Carbon Tetrachloride	56-23-5	2.15	0.204	0.204	5
Chloroform	67-66-3	27.6	0.207	0.207	80

Location ID — 069WP-008
Sample Month/Day/Year — 11/12/2012 : 4.3J CT [5-6]
Solids Concentration (mg/kg)
Data Qualifier
Analyte Abbreviate
Depth (Feet BGS)



N

0 100 Feet

PARSONS

Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

Figure 10
Proposed Shallow Groundwater Monitoring Wells
CC RVAAP-69 Building 1048 Fire Station
CC RVAAP-74 Building 1034
Motor Pool Hydraulic Lift

DESIGNED BY: BT			
DRAWN BY: LH			
CHECKED BY: EH	SCALE: As Shown	PROJECT NUMBER: 640030.0005.110051	
SUBMITTED BY: EH	DATE: June 2018	FIGURE NUMBER:	10
	FILE:		

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Table 1
Results of February 2018 Soil Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location		69-1048-SB110	69-1048-SB110	69-1048-SB110	69-1048-SB110	69-1048-SB110	69-1048-SB111	69-1048-SB111	69-1048-SB111	69-1048-SB112	69-1048-SB112	69-1048-SB113	69-1048-SB113	69-1048-SB113
Field Sample ID		069SB-110-0088-SO	069SB-110-9088-SO	069SB-110-0089-SO	069SB-110-0090-SO	069SB-111-0096-SO	069SB-111-0096-SO	069SB-111-0097-SO	069SB-111-0098-SO	069SB-112-0099-SO	069SB-112-9099-SO	069SB-113-0102-SO	069SB-113-0103-SO	069SB-113-0104-SO
Lab Sample ID		160-26664-1	160-26664-2	160-26664-3	160-26664-4	160-26664-5	160-26664-6	160-26664-7	160-26664-8	160-26664-9	160-26664-10	160-26664-12	160-26664-13	160-26664-14
Sample Date		2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018	2/6/2018
Sample Interval (feet bgs)		11-12	11-12	19-20	22-23	27-28	13-14	19-20	22-23	11-12	11-12	10-11	17-18	22-23
Sample Type		N	FD	N	N	N	N	N	N	N	FD	N	N	N
Chemical	**CAS Number**													
Volatile Organic Compounds (mg/kg)														
Carbon tetrachloride	56-23-5	**4.9**	**7 J**	0.0008 U	0.0009 U	0.00084 U	**0.5**	0.00088 U	0.00089 U	**7.7 J**	**9.6**	0.00086 U	0.00084 U	0.00096 U
Chloroform	67-66-3	**0.037**	**0.05 J**	0.0008 U	0.0009 U	0.00084 U	**0.059 J**	0.00088 U	0.00089 U	**0.1 J**	**0.098 J**	0.00086 U	0.00084 U	0.00096 U
Chloromethane	74-87-3	0.0049 U	0.0043 U	0.004 U	0.0045 U	0.0042 U	0.004 U	0.0044 U	0.0044 U	0.0046 U	0.0043 U	0.0043 U	0.0042 U	0.0048 U
Methylene Chloride	75-09-2	0.0049 U	0.0043 U	0.004 U	0.0045 U	0.0042 U	**0.0033 J**	0.0044 U	0.0044 U	0.0046 U	0.0043 U	0.0043 U	0.0042 U	0.0048 U

Table 2
Results of February 2018 Groundwater Grab Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location		069WP-001	069WP-002	069WP-003	069WP-004	069WP-005	069WP-006	069WP-007	069WP-008	069WP-009	069WP-010	069WP-011	069WP-012
Field Sample ID		069WP-001-0001-GW	069WP-002-0001-GW	069WP-003-0001-GW	069WP-004-0001-GW	069WP-005-0001-GW	069WP-006-0001-GW	069WP-007-0002-GW	069WP-008-0002-GW	069WP-009-0001-GW	069WP-010-0001-GW	069WP-011-0001-GW	069WP-012-0001-GW
Lab Sample ID		160-26602-1	160-26602-2	160-26602-3	160-26602-4	160-26687-2	160-26687-3	160-26741-2	160-26741-3	160-26687-6	160-26687-7	160-26696-2	160-26717-2
Sample Date		2/1/2018	2/1/2018	2/1/2018	2/1/2018	2/7/2018	2/7/2018	2/12/2018	2/12/2018	2/7/2018	2/7/2018	2/8/2018	2/9/2018
Sample Interval (feet bgs)		7-12	6-16	6-16	10-12	10-20	6-16	6-16	10-20	6-16	2-12	4-24	6-16
Sample Type		N	N	N	N	N	N	N	N	N	N	N	N
Chemical	**CAS Number**												
Volatile Organic Compounds (µg/L)													
Carbon tetrachloride	56-23-5	**1,000**	**7.3**	**230**	**320**	5 U	**3.2 J**	0.25 U	0.25 U	2.5 U	0.25 U	0.25 U	1.3 U
Chloroform	67-66-3	**110**	**1.2**	**150**	**190**	5 U	**0.7 J**	0.25 U	0.25 U	2.5 U	0.25 U	0.25 U	1.3 U
Chloromethane	74-87-3	5 U	0.25 U	0.63 U	1.3 U	5 U	0.25 U	0.25 UJ	0.25 UJ	2.5 U	0.25 U	0.25 U	1.3 UJ
Methylene Chloride	75-09-2	10 U	0.5 U	1.3 U	2.5 U	10 UJ	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	2.5 U

Table 2
Results of February 2018 Groundwater Grab Sampling
CC RVAAP-69 Building 1048 Fire Station

Site		CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69
Sample Location		069WP-013	069WP-014	069WP-015	069WP-016	069WP-017
Field Sample ID		069WP-013-0001-GW	069WP-014-0001-GW	069WP-015-0001-GW	069WP-016-0001-GW	069WP-017-0001-GW
Lab Sample ID		160-26696-3	160-26741-4	160-26741-5	160-26778-3	160-26806-2
Sample Date		2/8/2018	2/12/2018	2/12/2018	2/14/2018	2/15/2018
Sample Interval (feet bgs)		1-16	6-16	10-20	6-16	5-20
Sample Type		N	N	N	N	N
Chemical	**CAS Number**					
Volatile Organic Compounds (µg/L)						
Carbon tetrachloride	56-23-5	0.25 U	0.25 U	0.25 U	**1**	0.25 U
Chloroform	67-66-3	0.25 U	0.25 U	0.25 U	**0.41 J**	0.25 U
Chloromethane	74-87-3	0.25 U	0.25 UJ	0.25 UJ	0.25 U	0.25 U
Methylene Chloride	75-09-2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Table 3
Results of March 2018 Groundwater Monitoring Well Sampling
CC RVAAP-69 Building 1048 Fire Station and CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift

Site		CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-69	CC RVAAP-74	CC RVAAP-74	CC RVAAP-74	CC RVAAP-74
Sample Location		069MW-001	069MW-002	069MW-003	069MW-004	069MW-005	074MW-001	074MW-002	074MW-003	074MW-003
Field Sample ID		069MW-001-0001-GW	069MW-002-0001-GW	069MW-003-0001-GW	069MW-004-0001-GW	069MW-005-0001-GW	074-MW-001-0001-GW	074-MW-002-0001-GW	074-MW-003-0001-GW	074-MW-003-9001-GW
Lab Sample ID		160-27124-2	160-27124-3	160-27124-4	160-27124-5	160-27124-6	160-27167-2	160-27167-3	160-27167-4	160-27167-5
Sample Date		3/5/2018	3/5/2018	3/5/2018	3/5/2018	3/6/2018	3/6/2018	3/6/2018	3/6/2018	3/6/2018
Sample Interval (feet bgs)		5-15	5-15	23-28	8-18	7-17	12-22	10-20	10-20	10-20
Sample Type		N	N	N	N	N	N	N	N	FD
Chemical	**CAS Number**									
Volatile Organic Compounds (µg/L)										
Carbon tetrachloride	56-23-5	**370**	**3.7**	0.25 U	**190**	**4.8**	0.25 U	0.25 U	0.25 U	0.25 U
Chloroform	67-66-3	**32**	**0.67 J**	**34**	**96**	**0.56 B**	0.25 U	0.25 U	0.25 U	0.25 U
Chloromethane	74-87-3	0.63 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Methylene Chloride	75-09-2	**1.9 J**	0.5 U	**15**	**0.47 J**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

PARSONS

CC RVAAP-69
069MW-001

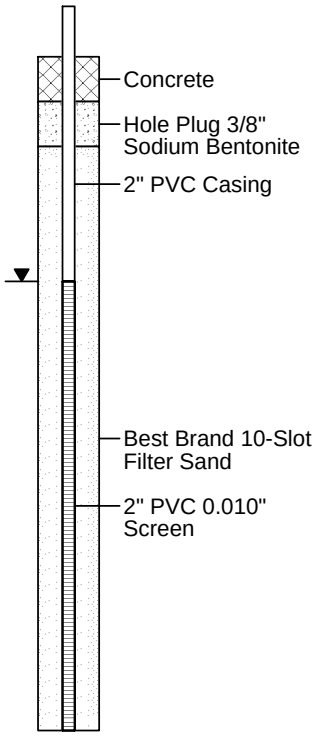
RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

Start Date	: 8 February 2018
End Date	: 8 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551524.76
Easting Coord.	: 2357766.03
Total Depth of Boring	: 15.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	Brown, moist, CLAY, silt, sand, trace gravel.		
2		100					
3	2			0.0			
4							
5	3			0.0	Wet at approximately 5'		
6		100				CL	
7	4			0.0			
8							
9	5			0.0			
10		90					
11	6			0.0			
12					Gray, moist to wet, CLAY, silt, sand, trace gravel.		
13	7	100		0.0		CL	
14							
15	8			0.0	End of boring at 15.0'.		
16					Notes:		
17					Ground Surface Elevation: 1024.69		
18					Well riser: Extends 2.56' above surface elevation		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Well: 069MW-001
TOC Elev.: 1027.25



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PARSONS

CC RVAAP-69
069MW-002

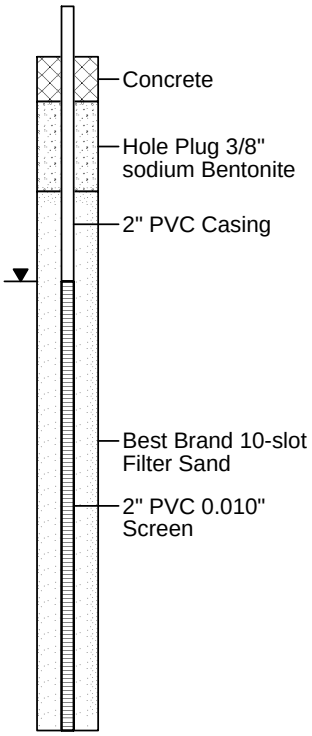
RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

Start Date	: 12 February 2018
End Date	: 12 February 2018
Weather	: 10 F/Clear
Northing Coord.	: 551537.19
Easting Coord.	: 2357718.33
Total Depth of Boring	: 16.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.		
2		100					
3	2			0.0			
4							
5	3			0.0	Wet at approximately 5'		
6		100				CL	
7	4			0.0			
8							
9	5			0.0			
10		100					
11	6			0.0			
12					Gray, moist, CLAY, silt, sand, trace gravel.		
13	7			0.0			
14		100				CL	
15	8			0.0			
16					End of boring at 16.0'.		
17					Notes:		
18					Ground Surface Elevation: 1025.11		
19					Well Riser: Extends 3.17' above surface elevation		
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Well: 069MW-002
TOC Elev.: 1028.28



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PARSONS

CC RVAAP-69
69-1048-SB110/069MW-003

RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

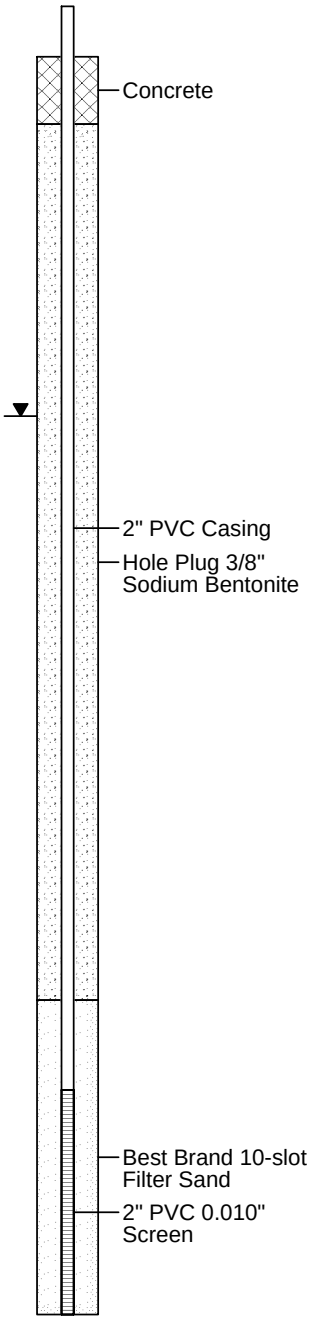
Start Date	: 6 February 2018 (Boring)
End Date	: 14 February 2018 (Well)
Weather	: 10 F/Snow
Northing Coord.	: 551516.85
Easting Coord.	: 2357765.97
Total Depth of Boring	: 28.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–7	1–4	100		0.0	Brown, moist, slightly plastic, CLAY, silt, trace gravel.	CL	
8–10	5–6	100	069SB-110-0088-SO	0.0	Brown, wet, SILTY SAND, with some clay.	SM	
12–15	7–8	100		0.0	Brown grading to gray, slightly plastic, CLAY, silt, sand, with thin wet sandy layers.	CL	
16–18	9–10	100	069SB-110-0089-SO	0.0	Gray, wet, CLAY, silt, sand.	CL	
19–22	10–12	100	069SB-110-0090-SO	0.0	Weathered SANDSTONE	SS	
23–27	12–14	100	069SB-110-0091-SO	0.0			
28					Refusal at 28.0'.		

Notes:
Ground Surface Elevation: 1024.73
Well Riser: Extends 2.55' above surface elevation

Well: 069MW-003
TOC Elev.: 1027.28



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PARSONS

CC RVAAP-69
069MW-004

RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

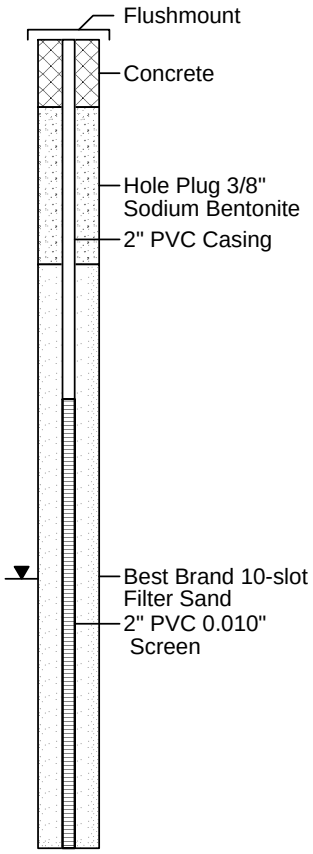
Start Date	: 20 February 2018
End Date	: 20 February 2018
Weather	: 60 F/Cloudy
Northing Coord.	: 551415.01
Easting Coord.	: 2357873.25
Total Depth of Boring	: 20.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5' zx 4' long acetate liner
	: 2' x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1			0.0	Degraded asphalt and gravel.	AR	
1–2		100			Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
2–3	2			0.0			
3–4							
4–5	3			0.0			
5–6		100					
6–7	4			0.0			
7–8							
8–9	5			0.0			
9–10		100					
10–11	6			0.0			
11–12					Wet		
12–13	7			0.0			
13–14		100					
14–15	8			0.0			
15–16							
16–17	9			0.0			
17–18		100					
18–19	10			0.0	Gray, wet, CLAY, silt, sand.	CL	
19–20							
20					End of boring at 20.0'.		

Notes:
Ground Surface Elevation: 1024.79
Concrete Elevation: 1024.75

Well: 069MW-004
TOC Elev.: 1024.19



PARSONS

CC RVAAP-69
069MW-005

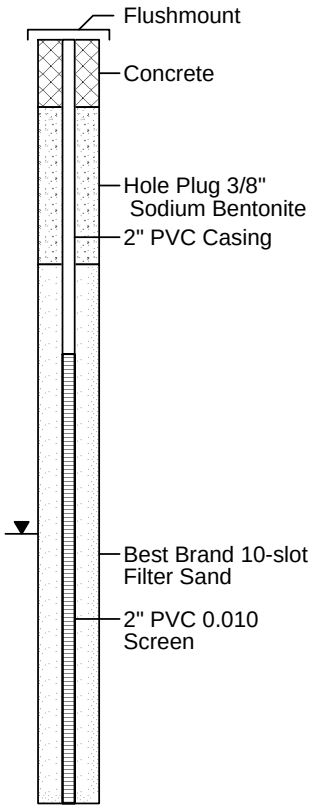
RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

Start Date	: 20 February 2018
End Date	: 20 February 2018
Weather	: 60 F/Cloudy
Northing Coord.	: 551478.08
Easting Coord.	: 2357920.65
Total Depth of Boring	: 20.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0–1	1			0.0	Topsoil Brown, moist, CLAY, silt, sand, trace gravel.		
1–2		90					
2–3	2			0.0			
3–4							
4–5	3			35.2			
5–6		100					
6–7	4			3.2		CL	
7–8							
8–9	5			0.0			
9–10		100					
10–11	6			0.0	Wet		
11–12							
12–13	7			0.0			
13–14		100					
14–15	8			0.0	4" coarse SAND layer	SW	
15–16					Brown, wet, CLAY, silt, sand, trace gravel.	CL	
16–17	9			0.0	Gray, CLAY, silt, sand, trace gravel.		
17–18		100				CL	
18–19	10			0.0			
19–20							
20–21					End of boring at 20.0'.		
21–22					Notes: Ground Surface Elevation: 1023.84 Concrete Elevation: 1023.76		
22–30							

Well: 069MW-005
TOC Elev.: 1023.18



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PARSONS

RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

CC RVAAP-69
69-1048-SB111

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551532.30
Easting Coord.	: 2357780.78
Total Depth of Boring	: 23.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB111
Surf. Elev.: 1025.08

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	CL	
2		100					
3	2			0.0			
4					Brown, wet, CLAY, silt, sand, trace gravel.		
5	3			0.2		CL	
6		100			Gray, moist, CLAY, silt, and sand.		
7	4			0.2			
8							
9	5			0.0			
10		100					
11	6			0.0			
12					Gray, wet, CLAY, silt, and sand.		
13	7		069SB-111-0096-SO	0.0		CL	
14		100					
15	8			0.0			
16							
17	9			0.0			
18		100					
19	10			0.0			
20			069SB-111-0097-SO		Weathered SANDSTONE		
21	11	100		0.0		SS	
22	12						
23			069SB-111-0098-SO		Refusal at 23.0'.		
24							
25							
26							
27							
28							
29							
30							

Hole Plug 3/8" Sodium Bentonite

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PARSONS

RVAAP PBA Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

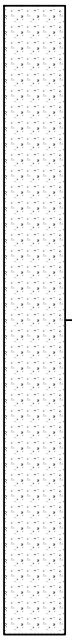
CC RVAAP-69
69-1048-SB112

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551471.53
Easting Coord.	: 2357813.93
Total Depth of Boring	: 14.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB112
Surf. Elev.: 1024.86

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Topsoil		
1	1			0.0	Brown, moist, CLAY, silt, sand, trace gravel.	CL	
2		75			Wet SAND with some gravel, silt, and clay.		
3	2			0.0		SP	
4					Brown, moist, CLAY, silt, sand, trace gravel.		
5	3			0.0			
6		100					
7	4			0.0			
8					Brown, wet, CLAY, silt, sand, trace gravel.	CL	
9	5			0.0			
10		100					
11	6		069SB-112-0099-SO	0.0			
12							
13	7	100		0.0	Brown, stiff, CLAY, silt, sand, trace gravel.	CL	
14					Refusal at 14.0'.		
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							



PARSONS

CC RVAAP-69
69-1048-SB113

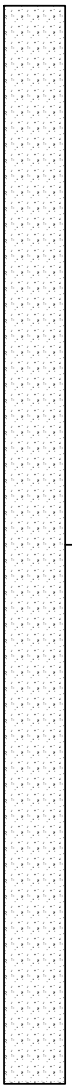
RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

Start Date	: 6 February 2018
End Date	: 6 February 2018
Weather	: 10 F/Snow
Northing Coord.	: 551468.49
Easting Coord.	: 2357760.17
Total Depth of Boring	: 24.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 2"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Boring: 69-1048-SB113
Surf. Elev.: 1025.93

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS
0					Topsoil	
1	1			0.0	Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	
2		75				
3	2			0.0		
4						
5	3			0.0		
6		100				CL
7	4			0.0		
8						
9	5			0.0		
10		100				
11	6		069SB-113-0102-SO	0.0	Brown, wet, SAND, with clay, silt, and gravel.	SP
12					Brown, moist, slightly plastic, CLAY, silt, sand, trace gravel.	
13	7			0.0		
14		100				CL
15	8			0.0		
16					Gray, moist, CLAY, silt, sand.	
17	9			0.0		
18		100	069SB-113-0103-SO			
19	10			0.0		
20						CL
21	11			0.0		
22		100	069SB-113-0104-SO			
23	12			0.0	Brown, weathered SANDSTONE	SS
24					End of boring at 24.0'.	
25						
26						
27						
28						
29						
30						



PARSONS

RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

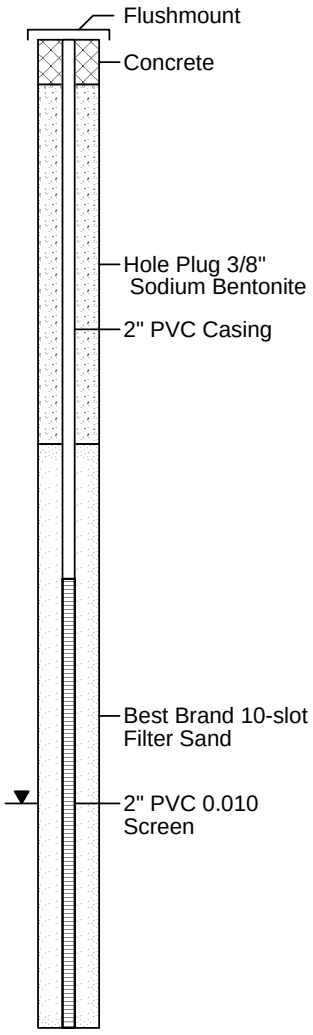
CC RVAAP-74
074MW-001

Start Date	: 9 February 2018
End Date	: 9 February 2018
Weather	: 20 F/Cloudy
Northing Coord.	: 551042.40
Easting Coord.	: 2358218.16
Total Depth of Boring	: 24.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25'
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Concrete	AR	
1	1			0.0	Gravel	GW	
2		50			Brown, moist, plastic, CLAY, silt, sand, trace gravel.		
3	2			0.0			
4						CL	
5	3			0.0			
6		100					
7	4			0.0	Black, organic layer with plant fibers.		
8					Brown, moist, stiff, CLAY, silt, sand, trace gravel.		
9	5			0.0			
10		100					
11	6			0.0			
12							
13	7			0.0			
14		100					
15	8			0.0		CL	
16							
17	9			0.0	Wet		
18		100					
19	10			0.0			
20							
21	11			0.0			
22		100			Gray, moist, CLAY, silt, sand, trace gravel.		
23	12			0.0		CL	
24					End of boring at 24.0'.		
25					Notes:		
26					Ground Surface Elevation: 1022.46		
27					Concrete Elevation: 1022.46		
28							
29							
30							

Well: 074MW-001
TOC Elev.: 1022.01



PARSONS

CC RVAAP-74
074MW-002

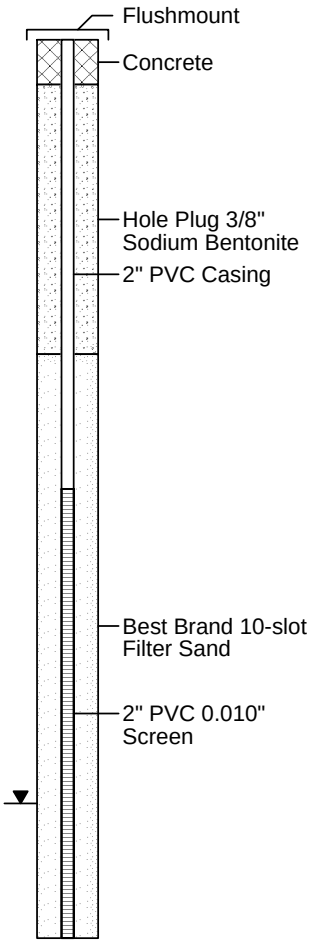
RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

Start Date	: 15 February 2018
End Date	: 15 February 2018
Weather	: 50 F/Cloudy
Northing Coord.	: 551039.63
Easting Coord.	: 2358243.37
Total Depth of Boring	: 24.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS	GRAPHIC
0					Concrete	AR	
1	1			0.0	Gravel	GW	
2		50			Brown, moist, SAND and GRAVEL	SP	
3	2			0.0			
4					Gray, moist, CLAY, silt, sand, trace gravel.	CL	
5	3			0.0			
6		100					
7	4			0.0	Black, organic layer with plant fibers.		
8					Brown, stiff, CLAY, silt, sand, trace gravel.	CL	
9	5			0.0			
10		100					
11	6			0.0			
12							
13	7			0.0			
14		100					
15	8			0.0			
16							
17	9			0.0	Wet		
18		100					
19	10			0.0			
20							
21	11			0.0			
22		75					
23	12			0.0	Gray, CLAY, silt, sand.	CL	
24					End of boring at 24.0'.		
25					Notes:		
26					Ground Surface Elevation: 1022.45		
27					Concrete Elevation: 1022.45		
28							
29							
30							

Well: 074MW-002
TOC Elev.: 1021.64



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PARSONS

CC RVAAP-74
074MW-003

RVAAP PBA 2018 Remedial Investigation
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, Ohio 44266
Portage County

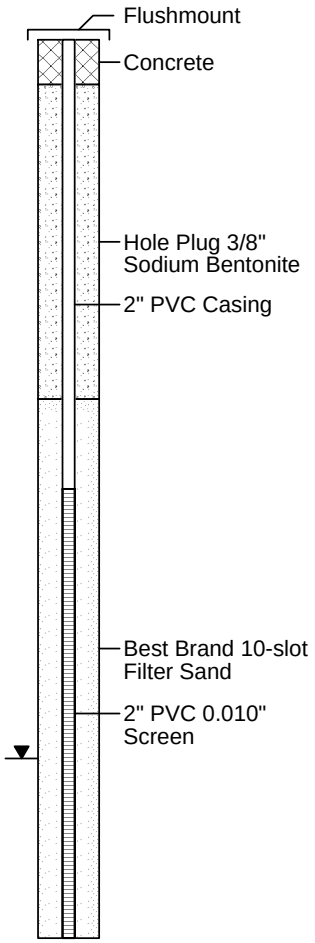
Start Date	: 16 February 2018
End Date	: 16 February 2018
Weather	: 30 F/Cloudy
Northing Coord.	: 551012.62
Easting Coord.	: 2358250.05
Total Depth of Boring	: 20.0'

Drilling Company	: Envirocore
Driller	: Tony Cramer
Designation of Drill	: Geoprobe 7822D
Type of Drill Rig	: Direct Push/Auger
Geologist	: Joe Peterlin
Oversight Company	: Parsons
Borehole Diameter	: 6.25"
PID Model	: MiniRAE Lite
Sampling Equipment	: 1.5" x 4' long acetate liner
	: 2" x 4' dual tube

Depth in feet	Samples	Recovery %	Sample ID	PID (ppm)	DESCRIPTION	USCS
0						
1	1			0.0	Asphalt and gravel	AR
2		75			Gray, slightly plastic, CLAY, silt, sand, trace gravel.	
3	2			0.0		
4						CL
5	3			0.0		
6		75				
7	4			0.0		
8					Black, organic layer with plant fibers.	
9	5			0.0	Brown, stiff, CLAY, silt, sand, trace gravel.	
10		100				
11	6			0.0		
12						CL
13	7			0.0		
14		100				
15	8			0.0		
16						
17	9			0.0	Brown, wet, stiff, CLAY, silt, sand, trace gravel.	
18		100				CL
19	10			0.0		
20					End of boring at 20.0'.	
21					Notes:	
22					Ground Surface Elevation: 1021.24	
23					Concrete Elevation: 1021.24	
24						
25						
26						
27						
28						
29						
30						

GRAPHIC

Well: 074MW-003
TOC Elev.: 1020.81



04-18-2018 P:\Ravenna Arsenal\Boring Logs\074MW-003.bor

Photographs of soil cores from SB110

0 – 4 Feet BGS – Brown clay

4 – 8 Feet BGS – Brown clay

Photographs of soil cores from SB110

8 – 12 Feet BGS – Brown silty sand (8-10 feet); brown grading to gray clay below 10 feet.

12 – 16 Feet BGS – Brown grading to gray clay. Gray clay below 14 or 15 feet bgs.

Photographs of soil cores from SB110

16 – 20 Feet BGS – Gray clay

20 – 24 Feet – Brown weathered sandstone

Photographs of soil cores from SB110

24 – 28 Feet BGS – Brown weathered sandstone

Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

September 25, 2018

Mr. David Connolly
Army National Guard Directorate
ARNGD-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859214

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Response to Ohio EPA Comments on the "Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated August 28, 2018

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the response to Ohio EPA comments on the "Update and Progress Report on the Remedial Investigation (RI) at CC RVAAP-69 Building 1048 Fire Station" at the former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. This response document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on September 4, 2018. The response was prepared for the U.S. Army Corps of Engineers on behalf of the National Guard Bureau by PARSONS.

The submitted response is to Ohio EPA's comment letter dated August 16, 2018, regarding the July 24, 2018 "Update and Progress Report on the Remedial Investigation (RI) at CC RVAAP-69 Building 1048 Fire Station." Ohio EPA provided 11 comments.

COMMENTS

The Army has satisfactorily responded, and Ohio EPA concurs with responses to comment numbers 1, 2, 4, 5, 6, 7, 8, 9, 10, and 11. Ohio EPA provides clarification of our requirements on Comment 3 below:

1. **Ohio EPA Comment 3.** In the report, isoconcentration maps of the combined parameters carbon tetrachloride and chloroform are presented in Figures 6 and 7. In these figures two isoconcentration lines are shown: 5 µg/L (the MCL for carbon tetrachloride) and one for 100 µg/L. The highest concentrations of carbon tetrachloride at sample locations on these maps are multiples of 100µ/L.

RECEIVED
26 SEPT 2018

First, the Army needs to delineate the concentrations of carbon tetrachloride and its degradation products to their respective FWCUG concentration (e.g., 0.24 µg/L for carbon tetrachloride and 0.27 µg/L for chloroform).

Additionally, for clarity, the isoconcentraion maps need to reflect the full range of concentrations of a given parameter. Also, Ohio EPA recommends iscocentrations maps be prepared for individual parameters instead of groups of parameters. An isocencentration line equivalent to a parameter's MCL may be included for reference.

Army Response to Comment 3. *As indicated in the legend for Figures 6 and 7, the isoconcentration lines are for carbon tetrachloride, not combined carbon tetrachloride and chloroform.*

Agree that concentrations of carbon tetrachloride and its degradation products will be delineated to their respective FWCUG concentrations. Additional monitoring wells will be installed as indicated on Figure 10 to complete plume delineation. Grab sample results (Figure 6) also provide information for plume delineation.

The isoconcentration lines of 5 µg/L and 100 µg/L are an appropriate level of detail given the data collected to date. Additional contours can be added to plume maps in the RI Report after additional wells are installed and samples are analyzed.

Ohio EPA Clarification. Ohio EPA concurs with the response in the first two paragraphs; however, to clearly represent the full range of concentrations of carbon tetrachloride, which ranges from 7.3 to 1000 ug/l within the contour map presented on Figure 6, which shows the results for "Groundwater Grab Samples," a more appropriate contour interval than one that ends at 100 ug/l should be provided on future maps.

This response to Ohio EPA comments was reviewed by personnel from Ohio EPA, DERR and Ground Water reviewers. Thank you for your response. We provided minor clarification for future submittals. Ohio EPA looks forward to completion of the Remedial Investigation of the RVAAP-69 Building 1048 Fire Station. If you have questions, please call me at (330) 963-1170.

Sincerely,

Ed D'Amato
Environmental Specialist
Division of Environmental Response and Revitalization

ED/nvp

ec: Katie Tait, OHARNG RTLS
Kevin Sedlak, ARNG
Rebecca Schreffler, Chenega
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Bob Princic, Ohio EPA, NEDO DERR
Mark Johnson, Ohio EPA, NEDO DERR

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

August 28, 2018

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Edward J. D'Amato, Project Coordinator
2110 East Aurora Road
Twinsburg, Ohio 44087-1924

Subject: Responses to Comments (dated August 16, 2018) on the "*Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station*" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated July 24, 2017, Ohio EPA ID# 267-000859-214

Dear Mr. D'Amato:

The Army appreciates your time and comments (dated August 16, 2018) on the *Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station*" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, dated July 24, 2018. Enclosed are responses to your comments.

This was a Final document that was shared for informational purposes with the Ohio EPA. The Army is not planning on issuing another version of the report. However, the revisions and comments provided by the Ohio EPA will be incorporated into the investigation approach and documented in the Remedial Investigation Report once the investigation is complete.

Please contact the undersigned at (703) 607-7589 or david.m.connolly8.civ@mail.mil if there are issues or concerns with these responses.

Sincerely,

Date: 2018.08.28 16:03:18 -04'00'

David M. Connolly
RVAAP Restoration Program Manager
Army National Guard Directorate

ec. Bob Princic, Ohio EPA, DERR-NEDO
Mark Johnson, Ohio EPA, DERR-NEDO
Tom Schneider, Ohio EPA, DERR-SWDO
Kevin Sedlak, ARNG
Katie Tait, OHARNG
Craig Coombs, USACE Louisville
Kevin Meiczkowski, USACE Louisville
Gail Harris, Vista Sciences Corp.
Ed Heyse, Parsons

Responses to Ohio EPA Comments (dated August 16, 2018)
***Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station* at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated July 24, 2017, Ohio EPA ID# 267-000859-214**

1. To be consistent with the Facility-Wide Groundwater Remedial Investigation and associated reports, the submitted document needs to identify the hydrostratigraphic units beneath Camp Ravenna by their accepted conventional names.

   Based on the elevation of the top of the weathered sandstone (about 1,005 feet AMSL), that hydrostratigraphic unit is the Upper Sharon Aquifer. In the report, the Upper Sharon Aquifer is variously referred to "weathered sandstone", "weathered bedrock", or the "deep zone." There are more than one sandstone hydrostratigraphic units beneath Camp Ravenna. For more information aboutthe elevations of the different bedrock hydrostratigraphic units beneath Camp Ravenna, refer to the cross-sections in: the *2017 Facility-Wide Ground Water Annual Report*, and/or *RI Work Plan*, and/or Geology *and Ground Water Resources of Portage County Ohio* (Winslow and White, 1966).

   Response: Agree that weathered sandstone layer is the Upper Sharon Aquifer. Text and Figures in the RI report will refer to this unit as the Upper Sharon Aquifer.

2. In the report's Summary of Findings (page 2), under the heading "Soil" (second bullet point), the report incorrectly states:

   Carbon tetrachloride and chloroform were detected in soil samples above 14 feet bgs (in the brown clays, sands, and silts), which is consistent with previous investigations.

   Figure 2 in the report shows that carbon tetrachloride was detected in the 2015 sample from soil boring 69-1048SB-101 at a depth of 14-15 feet bgs (4.6µg/L) and a depth of 15-16 feet Bgs (3.2 µg/L [j]).

   Response: Clarification. Please note that soil concentrations displayed in Figure 2 are in units of mg/kg, not µg/L. Agree that carbon tetrachloride was detected in samples from 69-1048SB-101 at depths of 14-15 and 15-16 feet bgs in 2015. Please note that these samples are within the brown clays, sands and silts and above the gray clay layer, which is consistent with the soil layers where carbon tetrachloride was detected in samples collected from borings installed in 2018. Please see cross-section Figure 3.

3. In the report, isoconcentration maps of the combined parameters carbon tetrachloride and chloroform are presented in Figures 6 and 7. In these figures, two isoconcentration lines are shown: 5 µg/L (the MCL for carbon tetrachloride) and one for 100 µg/L. The highest concentrations of carbon tetrachloride at sample locations on these maps are multiples of 100µ/L.

   First, the Army needs to delineate the concentrations of carbon tetrachloride and its degradation products to their respective FWCUG concentration (e.g., 0.24 µg/L for carbon tetrachloride and 0.27 µg/L for chloroform).

   Additionally, for clarity, the isoconcentraion [sic] maps need to reflect the full range of concentrations of a given parameter. Also, Ohio EPA recommends iscocentrations [sic] maps be prepared for individual parameters instead of groups of parameters. An isocencentration [sic] line equivalent to a parameter's MCL may be included for reference.

Response: As indicated in the legend for Figures 6 and 7, the isoconcentration lines are for carbon tetrachloride, not combined carbon tetrachloride and chloroform.

Agree that concentrations of carbon tetrachloride and its degradation products will be delineated to their respective FWCUG concentrations. Additional monitoring wells will be installed as indicated on Figure 10 to complete plume delineation. Grab sample results (Figure 6) also provide information for plume delineation.

The isoconcentration lines of 5 µg/L and 100 µg/L are an appropriate level of detail given the data collected to date. Additional contours can be added to plume maps in the RI Report after additional wells are installed and samples are analyzed.

4. Ohio EPA agrees that the March 2018 water level data suggests a downward ground water gradient between the Unconsolidated and Upper Sharon Aquifers near the location of well pair 069MW-001/069MW-003.

   Response: Comment noted.

5. Page 3 of the report claims that the gray clay layer beneath CC RVAAP-69 is limiting the vertical migration of ground water.

   Given the presence of the degradation products chloroform (34 µ/L) and methylene chloride (15 µ/L) in "weathered sandstone" (Upper Sharon Aquifer) well 69MW-003 it is premature for the ARMY to make this claim.

   It is unclear that the gray clay layer is laterally continuous enough and thick enough to be an effective barrier between the Unconsolidated Aquifer and the Upper Sharon Aquifer to prevent downward migration of contamination.

   For more information about evaluating whether a clay or low permeability layer adequately protects underlying ground water when an overlying ground water zone is contaminated, refer to Ohio EPA's 2009 *Technical Guidance Manual* Supplement document entitled: *Assessment of an Aquitard during a Ground Water Contamination Investigation.*

   Response: The report states: *"The three-foot difference in hydraulic head between these wells* [069MW-001 and 069MW-003] *suggests that the gray clay layer (located between the two screened intervals) is limiting vertical migration of groundwater."* This observation is a reasonable interpretation of the data at this well pair.

   The Army acknowledges that the extent of the gray clay layer and its role and effectiveness as a barrier between the Unconsolidated Aquifer and the Upper Sharon Aquifer remain to be determined. To that end, the report indicates that additional soil borings (SB114 and SB115) will be completed to the top of the Upper Sharon Aquifer, and the potential for vertical migration of carbon tetrachloride decay products will be investigated by continued monitoring of well 069MW-003 and, if needed, installation of additional deep monitoring wells.

6. The report indicates that chloroform and methylene chloride contamination in well 069mw-003 may have been introduced during drilling.

   If the presence of chloroform and methylene chloride in "weathered sandstone" (Upper Sharon Aquifer) is an artifact of cross-contamination originating in the Unconsolidated Aquifer and introduced into the well 069MW-003 during its installation and not removed

due to inadequate development, one would expect a detectable quantity of carbon tetrachloride to be present in that well and it is not.

If the Army believes that chloroform and methylene chloride were introduced by drilling, then it is not clear why they proposed in the report (page 5) to wait until after the June 2018 sampling event to redevelop well 069MW-003. This needs to be explained.

Response: The Army decided to wait until after the June 2018 sampling event to determine if the results of the March 2018 sampling event would be confirmed.

7. Page 4 of the report states: "Carbon tetrachloride DNAPL is unlikely to be present because dissolved concentrations in ground water are much lower that (sic) the solubility limit of 800,000 ug/l."

   The facility has not adequately demonstrated that DNAPL is not present in the vicinity of Building 1048 Fire Station. According to the Interstate Technology and Regulatory Council's (ITRC's) 2015 guidance document entitled *Integrated DNAPL Site Characterization and Tools Selection:*

   > *Historically,* a *1% dissolved-phase concentration of chlorinated solvent DNAPL, based on compound-specific solubility in ground water, was thought to be indicative of potential presence of DNAPL; however, this method is now viewed as unreliable (that is, either falsely positive or falsely negative.)*

   It is unclear if the Army gauged any of the monitoring wells for DNAPL during sampling. This needs to be clarified. According to Chapter 10 of Ohio EPA's Technical Guidance Document (TGM) [2012]:

   > *If the presence of NAPL is suspected, the sampling program should include devices and protocols to detect them.*

   If the ARMY has not gauged the CC RVAAP - 69 Building 1048 Fire Station's monitoring wells for DNAPL, it needs to gauge them to demonstrate the presence or absence of DNAPL. Protocols to detect immiscible liquids should also include the visual inspection of purge water and any equipment removed from the well.

   Response: All wells are gauged with an interface probe. To date no NAPL has been detected. Wells will be gauged for DNAPL during all subsequent monitoring events. There was no indication of DNAPL in well development or purging notes, and concentrations in waste characterization samples of purge water were well below solubility.

8. The report indicates (page 3 and Figures 6 and 7) that a ground water data gap exists north of well 069MW-001. However, the Army has not proposed any additional Unconsolidated Aquifer monitoring wells in this area. This needs to be explained.

   Response: Additional well 069MW-006 will be installed northwest of existing well 069MW-002 and will provide additional delineation to the north of 069MW-001. Results from new well 069MW-006 and grab sample 069WP-017 (Figure 6) are expected to provide adequate delineation on the north side of the plume.

9. Ohio EPA agrees that if chlorinated methanes continue to be detected in well 069MW-003 that the Army will have to install additional wells in the Upper Sharon Aquifer in the

vicinity of CC RVAAP-69 to delineate contamination in that hydrostratigraphic zone.

Response: Comment noted.

10. On Figure 8 and 10, the practical quantification limit (PQL) for carbon tetrachloride in the March 2018 ground water sample from well 069MW-003 is listed as 0.18 µg/L, and in Table 3 of the report the PQL for that sample is listed as 0.25 µg/L. It needs to be clarified what the PQL for carbon tetrachloride in March 2018 sample from 069MW-003 is.

    Response: The detection limit was 0.18 µg/L and level of detection (LOD) was 0.25 µg/L. In accordance with the QAPP and DoD Quality Systems Manual, we will report the non-detections at the LOD (in this case, 0.25 µg/L) in all figures and tables in the RI report.

11. The report contains a few typographical errors that should be corrected to improve the clarity of the report.

    On page 3 under the third bullet item: "well 06MW-003" should be "well 069MW-003" and "1,016.7 feet bgs" should be "1,016.7 feet AMSL. Also, on Figure 2 soil boring "72-1048RVSB2" should be "69-1048RVSB2".

    Response: Comment noted.

Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

August 16, 2018

Mr. David Connolly
Army National Guard Directorate
Environmental Programs Division
ARNG-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Re: US Army Ammunition PLT RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859214

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Ohio EPA Comments on the "Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated July 24, 2018, Ohio EPA ID # 267-000859-214

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the **"Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station"** at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on July 24, 2018. The report was prepared for the US Army Corps of Engineers on behalf of the U.S. Army National Guard Bureau by PARSONS.

The Army has not completed the assessment of the CC RVAAP-69 Building 1048 Fire Station (CC RVAAP-69). This review is based only on the work done by the Army to date, and proposed work to delineate ground water impacts in the area. Because CC RVAAP-69 ground water contamination issues are captured under the Facility-wide Groundwater Remedial Investigation, Ohio EPA requests that we have the opportunity to comment on further efforts to delineate impacts to ground water in this area as the work proceeds.

Comments on the current Update Report based on Ohio EPA review are provided below. Please provide responses to the enclosed comments in accordance with the Directors Findings and Orders.

BACKGROUND

The RVAAP-69, is the former location of Building 1048 Fire Station. It is located in the northwest quadrant of the intersection of George Road and South Service Road. No documentation was found regarding the specific years of service for the fire station. A site schematic dated 1941 shows the fire station, which was razed in 2008. The fire station is currently vacant land. Depth to ground water in this area is expected to be between 10 and 20 feet below ground surface (bgs).

Chemicals of potential concern (COPCs) associated with the fire station include carbon tetrachloride and its degradation products. Carbon tetrachloride was used through the 1950's to extinguish fires.

Previous Remedial Investigation (RI) sampling of CC RVAAP-69 Building 1048 Fire Station (CC RVAAP-69) was conducted in 2012 and 2015.

Subsurface geology beneath CC RVAAP 69 typically consists of 15 to 19 feet of interbedded brown clay, silt, and sand (surface elevation [about 1025 feet AMSL] to about 1,010 feet AMSL) overlying 5 to 7 feet of gray clay (1,010 feet AMSL to 1,003 feet AMSL) overlying "weathered brown sandstone" (1,003 to 1,005 feet AMSL).

UPDATE/PROGRESS REPORT ON RI INVESTIGATION AT CC-RVAAP-69 FIRE STATION

According to the report, the objectives of the 2017 Final Work Plan for investigations of CC RVAAP-69 are:

- Define the vertical extent of carbon tetrachloride in soil near boring 069SB-101;
- Define the lateral extent of carbon tetrachloride contamination in soil below a depth of 1,018 feet above mean sea level (AMSL); and
- Evaluate impacts to ground water.

Work Completed in February-March 2018. The report summarizes work done in February and March of 2018 to augment previous soil sampling done in 2012 and 2015 to support the stated goals of the Final Work Plan. The work completed in February and March of 2018 included:

- Advanced and sampled soil from four soil borings (69-1048SB-110, 69-1048SB-111,06-1048SB-112, 69-1048SB-113). Soil borings ranged in depth from 14 feet (69-1048SB-112) to 28 feet (69-1048SB-110) bgs. Multiple soil samples were analyzed for VOCs from each of the borings;

- Collected grab ground water samples for screening purposes using direct push techniques from 17 temporary well locations (refer to attached Figure 1). The 17 temporary wells were open to various interval lengths ranging from 5 (069WP-001) to 20 feet (069WP-011) in the Unconsolidated Aquifer; and

- Installed and sampled five new permanent monitoring wells. Four wells (069MW-001, 069MW-002, 069MW-004, and 069MW-005) were screened in the Unconsolidated Aquifer and were constructed with ten-foot long screens. One well (069MW-003) was screened in the weathered portion of "weathered sandstone" and was constructed with a five-foot long screen.

COMMENTS

1. To be consistent with the Facility-Wide Groundwater Remedial Investigation and associated reports, the submitted document needs to identify the hydrostratigraphic units beneath Camp Ravenna by their accepted conventional names.

   Based on the elevation of the top of the weathered sandstone (about 1,005 feet AMSL), that hydrostratigraphic unit is the Upper Sharon Aquifer. In the report, the Upper Sharon Aquifer is variously referred to "weathered sandstone", "weathered bedrock", or the "deep zone." There are more than one sandstone hydrostratigraphic units beneath Camp Ravenna. For more information about the elevations of the different bedrock hydrostratigraphic units beneath Camp Ravenna, refer to the cross-sections in: the *2017 Facility-Wide Ground Water Annual Report*, and/or *RI Work Plan*, and/or Geology *and Ground Water Resources of Portage County Ohio* (Winslow and White, 1966).

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Additionally, for clarity, the isoconcentraion maps need to reflect the full range of concentrations of a given parameter. Also, Ohio EPA recommends iscocentrations maps be prepared for individual parameters instead of groups of parameters. An isocencentration line equivalent to a parameter's MCL may be included for reference.

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   It is unclear that the gray clay layer is laterally continuous enough and thick enough to be an effective barrier between the Unconsolidated Aquifer and the Upper Sharon Aquifer to prevent downward migration of contamination.

   For more information about evaluating whether a clay or low permeability layer adequately protects underlying ground water when an overlying ground water zone is contaminated, refer to Ohio EPA's 2009 *Technical Guidance Manual* Supplement document entitled: *Assessment of an Aquitard during a Ground Water Contamination Investigation*.

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   > *Historically, a 1% dissolved-phase concentration of chlorinated solvent DNAPL, based on compound-specific solubility in ground water, was thought to be indicative of potential presence of DNAPL; however, this method is now viewed as unreliable (that is, either falsely positive or falsely negative.)*

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   > *If the presence of NAPL is suspected, the sampling program should include devices and protocols to detect them.*

   If the ARMY has not gauged the CC RVAAP – 69 Building 1048 Fire Station's monitoring wells for DNAPL, it needs to gauge them to demonstrate the presence or absence of DNAPL. Protocols to detect immiscible liquids should also include the visual inspection of purge water and any equipment removed from the well.

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9. Ohio EPA agrees that if chlorinated methanes continue to be detected in well 069MW-003 that the Army will have to install additional wells in the Upper Sharon Aquifer in the vicinity of CC RVAAP-69 to delineate contamination in that hydrostratigraphic zone.

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On page 3 under the third bullet item: "well 06MW-003" should be "well 069MW-003" and "1,016.7 feet bgs" should be "1,016.7 feet AMSL. Also, on Figure 2 soil boring "72-1048RVSB2" should be "69-1048RVSB2".

This Update and Progress Report on the Remedial Investigation at CC RVAAP-69 Building 1048 Fire Station was reviewed by personnel from Ohio EPA. Additional information is necessary to concur with approach provided for further investigation. If you have questions or would like to set up a meeting to discuss these comments, please call me at (330) 963-1292.

Sincerely,

Bob Princic for

Kevin M. Palombo
Environmental Specialist
Division of Environmental Response and Revitalization

KP/nvp

ec: Rebecca Schreffler, Chenega
Katie Tait, OHARNG RTLS
Kevin Sedlak, ARNG
Bob Princic, Ohio EPA, NEDO, DERR
Mark Johnson, Ohio EPA, NEDO, DERR
Rodney Beals, Ohio EPA, NEDO, DERR
Thomas Schneider, Ohio EPA, SWDO, DERR
Albert Muller, Ohio EPA, NEDO, DDAGW
Carrie Rasik, Ohio EPA, CO, DERR
Edward D'Amato, Ohio EPA, NEDO, DERR